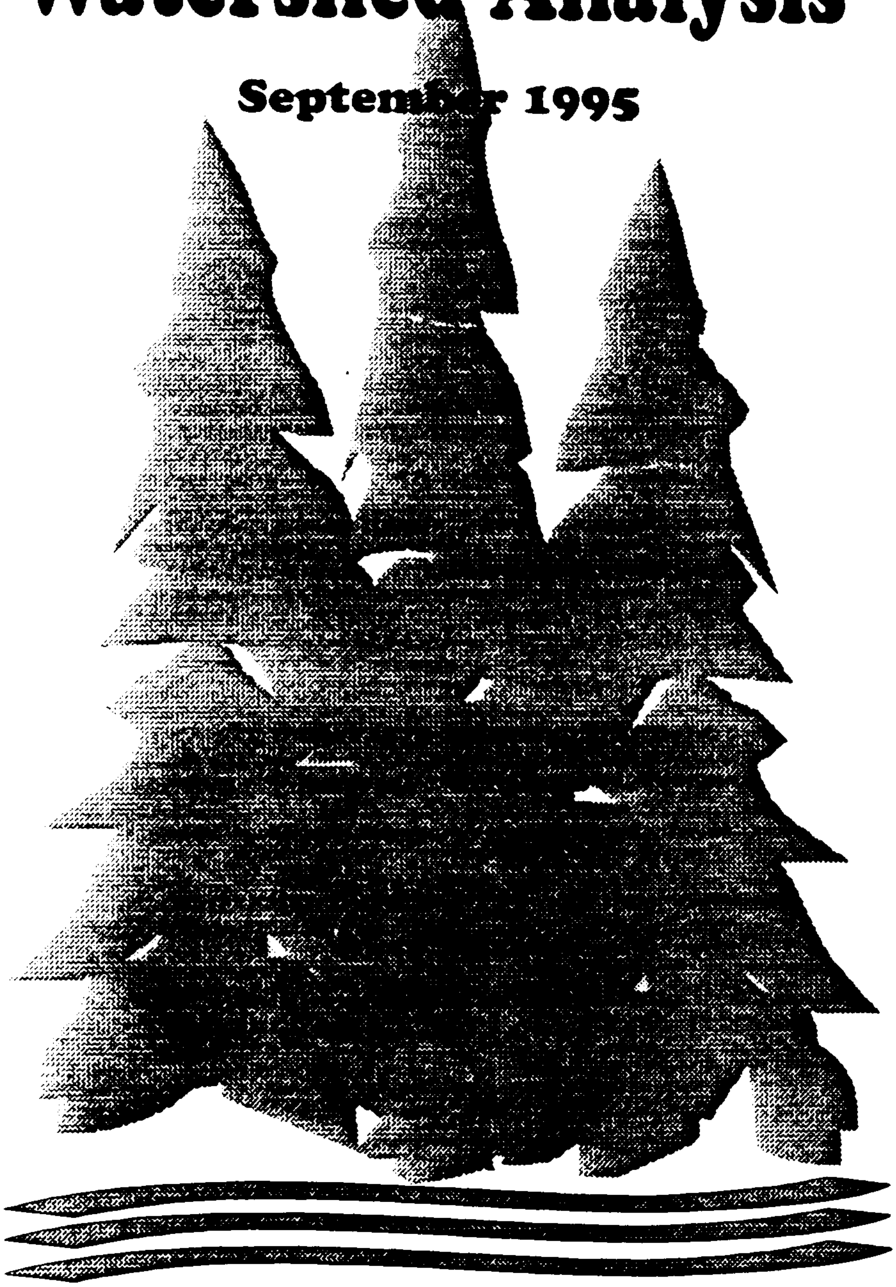
9/95 Ouimet

Little River Watershed Analysis

September 1995



USDA
Umpqua National Forest
North Umpqua Ranger District

USDI
Bureau of Land Management
Mt. Scott Resource Area

LITTLE RIVER WATERSHED ANALYSIS

Version 1.1

September 1995

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CHAPTER 1

AN INTRODUCTION TO WATERSHED ANALYSIS AND THE LITTLE RIVER WATERSHED

Introduction

Federal agencies have been directed to manage public lands as ecosystems. To accomplish this, the Northwest Forest Plan (ROD) calls for landscape-level analyses of the various components and interrelationships in the ecosystem. This is to be done on the scale of a 20 to 200 square mile watershed to document a scientifically based understanding of how that particular watershed works. By understanding the ecological history, processes, and limitations of the area, human needs and desires may be met in a sustainable manner without impairing the ability of the ecosystem to function.

Watershed analysis is not a detailed study of everything in the watershed. Instead, it is built upon the most important issues. For example, since cutthroat trout, steelhead, chinook and coho salmon, and steelhead trout are present in the watershed and their numbers are declining regionally and locally, the factors that affect these species are identified and characterized.

Watershed analysis is not a decision making process, nor is it intended to take the place of detailed, site specific project planning and analysis under the National Environmental Policy Act (NEPA). The analysis is meant to provide broad-based information that will help federal decision makers (District Ranger, Forest Supervisor, Area Manager and District Manager) make decisions on proposed projects under NEPA. A watershed analysis is also a flexible document and may be changed or added to as new information becomes available. This watershed analysis for Little River is the first iteration - changes to this document will be made as new data, monitoring results, and other findings become available.

A primary component of the Northwest Forest Plan is the Aquatic Conservation Strategy, which was developed to restore and maintain the ecological health of watersheds and the aquatic ecosystems contained within them on public lands. Watershed analysis is integral in meeting the Aquatic Conservation Strategy. When considering project implementation or management actions, federal decision makers will use the results of watershed analysis to support a finding that a management action either meets or does not prevent attainment of the Aquatic Conservation Strategy objectives (ROD p. B-10). Therefore, watershed analysis helps provide aquatic and riparian habitat protection by describing the processes that need to be considered when making land management decisions.

Watershed analysis will also play a role in the compliance of the Endangered Species Act. It will provide an avenue to assess habitat conditions for listed and proposed species. This information will then be available for use in planning and subsequent consultation with either the National Marine Fisheries Service (NMFS) for anadromous fish or the US Fish and Wildlife Service (USFWS) for species like the northern spotted owl, bald eagle, and peregrine falcon.

Finally, watershed analysis plays a role in compliance with the Clean Water Act. The primary objective of this Act is to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters." A principal task that watershed analysis will address for compliance will be the identification and evaluation of the factors influencing the health of the watershed and the beneficial uses of the water. Again, this requires a scientifically based understanding of the processes and interactions occurring within the watershed.

The Watershed Setting

The Little River watershed encompasses an area of 131,853 acres that ranges in elevation from 730 to 5,275 feet. Little River flows into the North Umpqua River eighteen miles east of Roseburg, Oregon in Douglas County (Figure 1). As one of the largest tributaries of the North Umpqua River, Little River supports a very diverse assemblage of fish species including five stocks of anadromous salmonids. The colder, high quality waters of the North Umpqua River help maintain relatively healthy and productive anadromous fish runs in the system compared to other rivers in the region.

Little River is where the coniferous forest of the western edge of the Cascade Mountains meets the eastern edge of the mixed hardwoods, prairies, and conifers of the Umpqua Valley hills. Three geologic provinces converge in the Little River watershed, making it truly a place of transitions. The Coast Range province, found in the northwest corner of the watershed, covers about 6% of the watershed area, and is characterized by ancient marine sediments and volcanic rocks, forming the hilly terrain just south of Glide. The northernmost extent of the Klamath geologic province is found in the western part of the watershed, and makes up 11% of the basin area. The remaining 83% of the basin is in the Western Cascades geologic province, which is composed of many layers of volcanic deposits which have eroded into deeply incised topography.

There are an estimated 1,200 people who live in the Little River watershed. Many residents draw surface water from the river and its tributaries for domestic and irrigation uses. The dominant use of the basin has been timber harvest. Due to Little River's proximity to the mills in Roseburg and because of its productive high volume forests, it was intensively harvested during the 1950's and 1960's; almost 60% of the drainage has been harvested and reforested to date.

As a result of forest harvest in Little River and throughout the region, wildlife populations have shifted from those that thrive in older forests to those populations that prefer younger forests and openings. Directly east and south of the watershed is a large late successional reserve that runs north and south along the west side of the Cascades (Figure 2). To the north and west of the watershed are a mix of private lands and public "matrix" lands primarily managed for timber production.

Figure 1

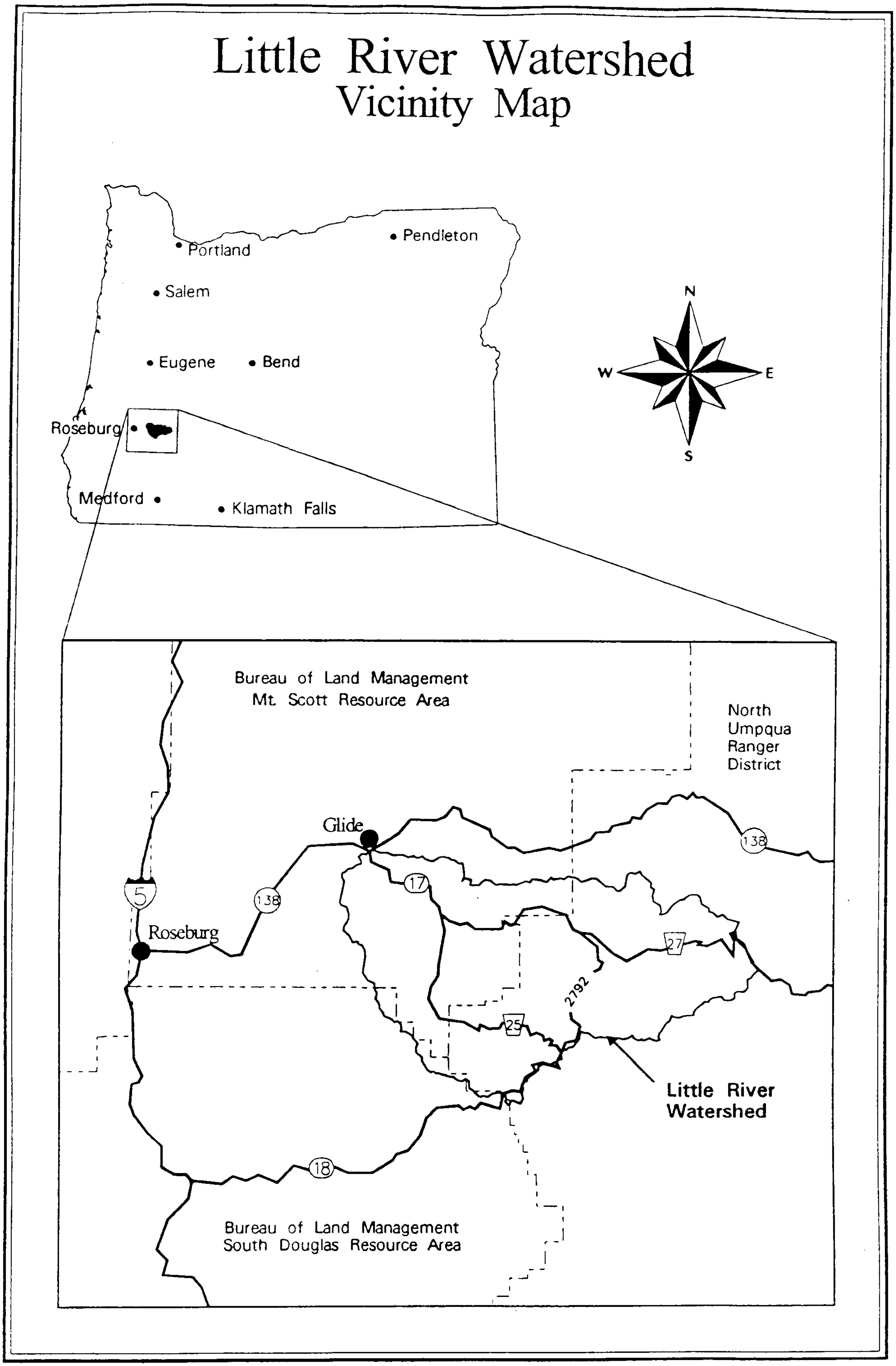

Little River Watershed
Vicinity Map
Portland
Pendleton
Salem
Eugene
Bend
Roseburg
Medford
Klamath Falls
N
W
E
S
Bureau of Land Management
Mt. Scott Resource Area
North
Umpqua
Ranger
District
Glide
138
5
Roseburg
17
27
2792
25
Little River
Watershed
18
Bureau of Land Management
South Douglas Resource Area

Figure 2

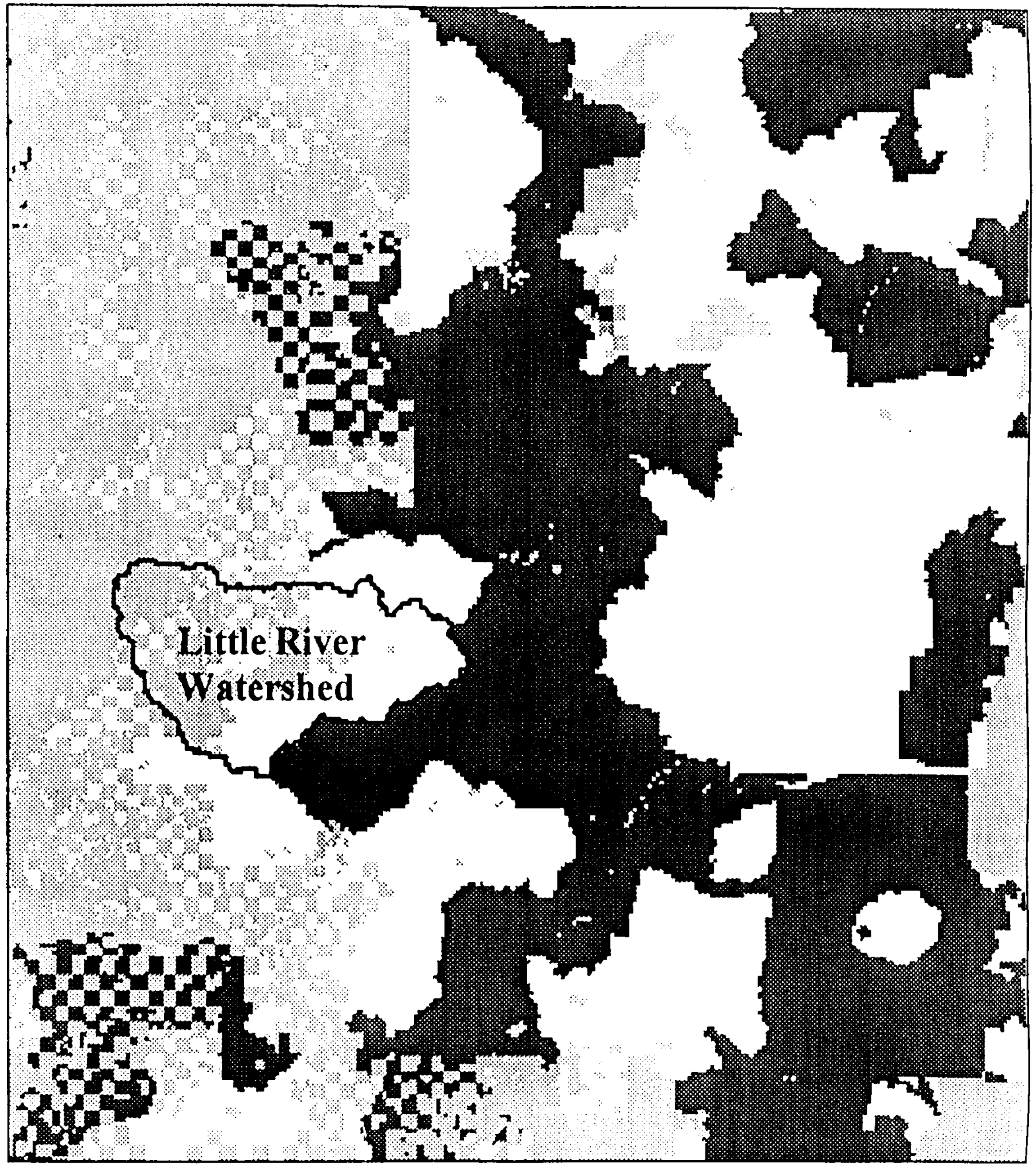
How Little River Fits In

The Little River watershed is located in Douglas County on BLM's Mount Scott Resource Area and the Forest Service's North Umpqua Ranger District. It encompasses the Little River and Cavitt Creek drainages and, at it's northwestern margins, extends into the oak woodlands and prairies of the Umpqua valley. Elevations range from 730 to 5,275 feet above sea level.

Reserves

Private Lands

Public Lands

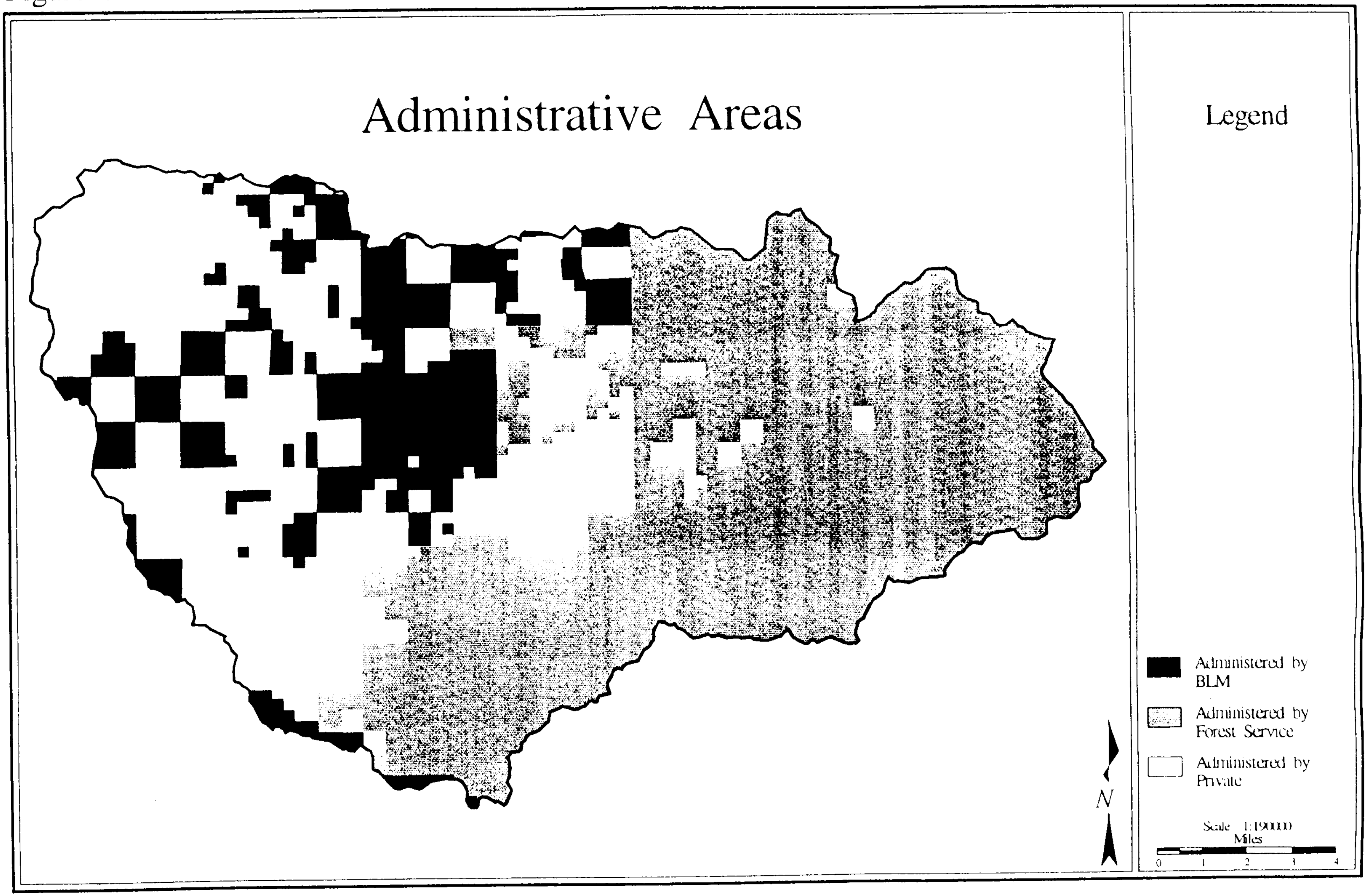


Recreational use has gradually increased over the decades as the road system was developed. Hunting, camping, fishing, swimming, hiking, and sight-seeing are the most popular recreational uses of the area today. Little River is the closest expansive area of public land outside the city of Roseburg which has a population of about 18,000.

Sixty-three percent of the watershed is public land administered by the USDA Forest Service (63,575 acres) and the USDI Bureau of Land Management (19,802 acres). The remaining 37% (44,772 acres) is private land (Figure 3). Most of the private lands (73%) are in blocks greater than 40 acres and are managed as industrial forest. Most of the homes are in the lower portions of Little River and Cavitt Creek where people operate small ranches or otherwise live in a rural setting.

The public land in Little River has been designated as one of the ten Adaptive Management Areas (AMA) in the Northwest Forest Plan. In AMA's, the objective is to learn how to manage on an ecosystem basis in terms of both technical and social challenges, and in a manner consistent with applicable laws. The specific emphasis of the Little River AMA is the development and testing of approaches to integration of intensive timber production with restoration and maintenance of high quality riparian habitat. To implement this direction, a series of adaptive management projects will be implemented and monitored. The findings in this watershed analysis help put the AMA emphasis into context and provide a foundation for management and restoration projects.

Figure 3


Administrative Areas
Legend
Administered by BLM
Administered by Forest Service
Administered by Private
N
Scale 1:190000
Miles
0
1
2
3
4

CHAPTER 2

ISSUES AND KEY QUESTIONS

One of the initial steps in watershed analysis requires issue identification and the formulation of key questions. The purpose of identifying issues is to focus the analysis on the processes and conditions that are most important to the watershed. Key questions are then formulated -- questions that watershed analysis will answer or that will lead to a monitoring plan. In Little River, these questions helped focus and drive data collection and analysis efforts.

The key questions fall under the broad topics of: 1) socio-economics; 2) road management; 3) wildlife and sensitive species; 4) forest productivity and fire management; and 5) fisheries, water, geology, soils.

Socio-economics

Jobs

This issue focuses on how public lands within the watershed will be managed to provide a sustainable flow of forest products, maximizing employment possibilities, while maintaining a healthy and productive ecosystem.

- What were the historical employment opportunities in the Little River watershed and how do they differ from today?

- What future job opportunities may exist in the watershed?

Recreation

This issue focuses on the need to continue to meet the demand for high quality recreation opportunities and experiences, while maintaining a healthy and productive ecosystem.

- What were/are the recreational opportunities in Little River?

- What future recreational opportunities exist and will there be a demand for more opportunities in the future?

Road Management

This issue focuses on the management of roads to address resource impacts they cause and meet the access needs of both the public and the managing agencies.

- What types of roads are most important in providing access for all users and uses?
- Which roads and vicinities pose the greatest risk for landslides and stream sedimentation?
- Which roads are a potential for closure or decommissioning?
- Which roads are priority for remaining open, but require upgrading or storm-proofing?

Wildlife and Sensitive Species

Native Species and Habitat Diversity

This issue explores the habitat conditions and populations of native species associated with early, mid, and late successional forests and unique unforested habitats in the Little River watershed.

- What is the estimated historic amount (range) of seral stages in the watershed prior to fire suppression and timber management and how does it compare to current amounts?
- How does the structure and composition of current seral stages of forest differ from those of pre-management times?
- What is the estimated historic condition of unique habitats in the watershed prior to fire suppression and timber management and how does it compare to current conditions?
- What is the degree of interior, late successional forest fragmentation in the watershed and how much interior forest currently exists and where? Is it stable or does it have a high probability of being disturbed in the near future?

Game Species

This issue examines the sustainability of current populations of game species (especially elk), and their distribution and availability to hunters.

- What effect will changing timber harvest rates and prescriptions have on game species?
- What is the estimated historic population of game species in the watershed and how does

that compare with current populations?

- What are the factors limiting the production of game species and how can habitat management be used as a tool to increase or sustain populations?

- What is the existing forage cover distribution in the watershed?

- Where are existing permanent forage areas and how can they be enhanced?

- Where are the best sites to create new forage areas (both transitory and permanent) and what species of grasses and forbs should be used for intensive forage production?

Non-Native Species

This issue looks at the effects of the introduction and spread of undesirable non-native species and the ability to limit further introduction and spread of harmful species.

- What ecological processes have been altered by non-native species that are present?

- What non-native species are posing the biggest risk to ecosystem integrity?

- What plant communities are most at risk and where are the areas of concern?

- What restorative actions are possible and where are the high priority areas for treatment?

Forest Productivity and Fire Management

This issue focuses on the ability to manage the landscape in order to sustain and/or enhance long term forest productivity (including intensive timber production) and resiliency to natural and human caused disturbance.

- Are there sites existing in public land that are growing at less than their potential and if so, why?

- Is vegetation in the Little River area matched to the site (representative of natural composition)? If not, are the discrepancies minor in occurrence or widely-spread?

- What proportions or areas of the landscape are the most/least productive for sustained timber management? Which ecological variables account for that productivity (i.e. soils, elevation, aspect, rainfall etc.)?

- Where are the priority treatment areas for increasing tree growth and for minimizing losses due to disturbances (such as fire and insects) or growth losses associated with compaction related to timber harvesting?

- How will the use of natural regeneration and/or uneven-aged management diversify stand structure and species composition?

- What have been the cumulative effects on native species or communities? What are the existing habitat conditions for federally listed and candidate species?

- What were the reference period fuel loads and vegetation patterns of the watershed and how does that compare to today's condition?

- Is there significant change in fuel loads and/or vegetation patterns which may influence the size and intensity of wildfire?

- What areas have high fire occurrence rates and high fuel hazards, and are there options to reduce the hazard?

- Is there a difference between the reference period fire regime and the existing fire regime?

Fisheries, Water, Geology, and Soils

Fish Stocks at Risk

At the regional scale, this issue focuses on the fact that there are three stocks of anadromous fish (Umpqua cutthroat trout, coastal coho salmon, and coastal steelhead trout) either petitioned or proposed for Federal listing under the Endangered Species Act within the Little River watershed. At the watershed scale, issues pertaining to these species focus on population viability and trends, as well as habitat condition and trends.

- What is the condition and trend of "at risk" fish stocks and their habitat within the Little River basin?

- How are fish populations within the watershed linked to the larger populations of the North Umpqua River downstream (i.e., Are there any refuge areas within the watershed? Is the habitat producing at its potential? etc.)?

Stream, Riparian, and Wetland Habitat

For fish stocks, this issue deals in part with specific measurable habitat parameters such as pool:riffle:glide ratios, amounts of large wood, streambed composition, number of quality pools per mile, bankfull width to depth ratios, etc.

- What is the extent and condition of aquatic habitat within the watershed, including wetlands, riparian areas, and streams (historic, current, and trend)?

- What are the critical processes and landforms that influence aquatic biodiversity?

- Where are the highly diverse aquatic communities within the watershed and how do they relate to the habitat types and conditions?

- What are the primary limiting factors to fish populations within the watershed?

Water Quality

This issue focuses on the most essential and basic natural resource that is present within the watershed, and its condition with regard to use by aquatic life, as well as humans. Specific areas of concern include high summer water temperatures, high pH, high turbidities during winter months, extremely low flows during summer months, and flow regimes which have been artificially altered.

- What is the thermal profile of the watershed (historic, current, trend)?

- Have other water quality parameters, such as dissolved oxygen, pH, and turbidity, affected aquatic communities? If so, how?

- How do flow regimes interact with/regulate water quality within the watershed?

- What, when, and where are the sedimentation/erosional processes occurring within the basin?

CHAPTER 3

TERRESTRIAL ECOSYSTEM

Uses of the Terrestrial Ecosystem

Human Uses

Human occupation

Human use of the Little River watershed can be traced as far back as 9,000 years ago (Connolly 1990). More recently, people of the Southern Molalla and Umpqua tribes inhabited the watershed. Many descriptions of encounters with the Umpqua exist (Appendix D).

Both the Southern Molalla and Umpqua peoples practiced migrational subsistence and settlement patterns, using the lowlands for winter villages and the uplands for task-specific campsites. This type of settlement allowed the cultures to utilize the anadromous fish runs, big game animals, and seasonal plant foods (Beckham 1986). Tribes utilized extensive trail networks throughout the Umpqua Valley. A trail, labeled the Klamath Trail on historical maps, followed Cavitt and Tuttle Creeks to Red Top Camp with branches following Salt Creek, a ridge along Slate Creek, as well as upper Granite and lower Corn Creeks, and was most likely an improved Indian trail.

To date, fifty-six archaeological sites have been recorded in Little River during federally mandated cultural resource surveys. These surveys, done in conjunction with timber sales, may have found only a fraction of the use that actually existed in Little River. Most of these sites were recorded on relatively flat ground, with almost half located on south aspects. Sites have been recorded on ridges, benches, stream terraces, bluffs, hills, and intermittent stream terraces. Within these areas, five types of archaeological sites have been recorded in Little River, including quarry (where tool stone can be located), cairn (where rock was piled for trail marking or spirit quests), rockshelter (shelters), lithic scatter (temporary camp sites associated with hunting and game processing), and village sites (where winter dwellings were located). Of the fifty-six sites in Little River, only one has been evaluated and determined to be eligible for the National Register of Historic Places.

More recent occupation consisted of explorers and fur traders, who were present around southwest Oregon from the 1820s to the 1840s. During the 1850s and 1860s, Euro-Americans established small farms and livestock ranches in the lowlands of the Little River watershed. Glide was settled in 1852. Settler's villages were established at Peel (in lower Little River) and Nofog (in the Cavitt Creek drainage) in the late 1800s. The Klamath trail, as mentioned above, was utilized by settlers to access the Cavitt Creek drainage and may have helped pave the way for early wagon roads which were later developed into the road system that helped establish access to the extensive timber in the watershed.

Today, over 18,000 people live in Roseburg, the nearest population center to the Little River watershed. The unincorporated communities of Glide, Idleyld Park, and Peel are experiencing some growth, but no census data specific to unincorporated areas is available. Populated areas within the watershed boundary occur mostly along Little River Road (County Rd. #17) and Cavitt Creek Road (County Rd. #82). Farming and ranching continue to be important to the area.

Population rates are expected to increase in Douglas County over the next several decades. More people mean a greater demand for goods and services, including a place to live, clean water to drink, outdoor places to recreate (that are easily accessible), and a myriad of forest products to consume. All of these demands will place a greater demand on forests located near population centers, such as those found in the Little River watershed.

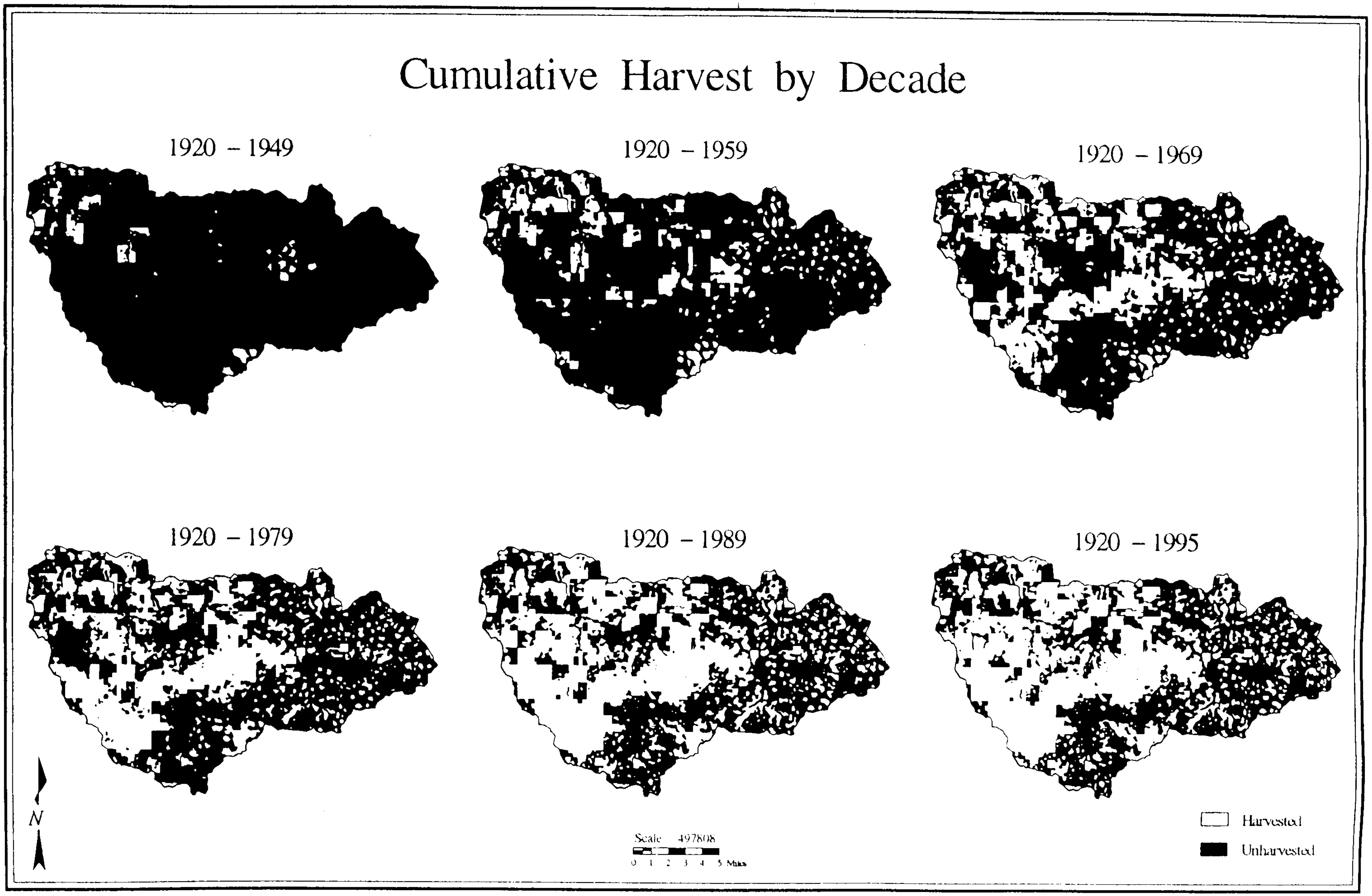
A Civilian Conservation Corps (CCC) camp was established at Wolf Creek, 12 miles up Little River in the 1930s. In 1965, it was transformed into a Job Corps, where young men and more recently, women, learn trades and earn High School Equivalency Degrees. Present day students (now at 231 students) have the opportunity to learn various trades such as carpentry, forestry, and culinary arts. Students are given the opportunity to practice their vocational skills on various projects throughout Douglas County, providing communities with a skilled workforce. Schools, non-profit groups, and government agencies utilize the students to construct buildings, develop parks, maintain trails, and suppress fires, making the Wolf Creek Job Corps an important partner in the development and maintenance of Douglas County's many communities.

Lookouts, for use in fire detection, were established in the Little River watershed as early as 1918 and were located on Big Squaw Mountain, Flat Rock, Lookout Mountain, Red Butte, Shivigny Mountain, Taft Mountain, and White Rock. Today, only the lookout on Red Butte remains.

Timber Harvest

With the end of World War II, the demand for lumber swelled. Timber harvesting in the Little River watershed began in earnest in the 1940s and 1950s, following the road system as it continued to be developed throughout time (Figure 4). Early harvesting and road building accessed the biggest trees found on gentle slopes. These early entries were often in lower elevations on the most productive ground. Harvest areas were large in size, ranging from 40 to 100 or more acres - much larger than the average size of the recent past (Table 1).

Figure 4



Cumulative Harvest by Decade
1920 - 1949
1920 - 1959
1920 - 1969
1920 - 1979
1920 - 1989
1920 - 1995
N
Scale 497808
0 1 2 3 4 5 Miles
Harvested
Unharvested

Table 1. Acres of timber harvest by decade and vicinity for all land ownerships in the Little River watershed.

Vicinity	1940 acres	1950 acres	1960 acres	1970 acres	1980 acres	1990 acres	Totals
Lower Little River	922	3423	2604	9766	3271	702	11898
Cavitt Creek	595	2438	9548	5655	3569	889	22694
Middle Little River	735	3628	3094	1918	2166	775	12316
Wolf Plateau	127	2838	4143	2499	1367	404	11377
Emile Creek	0	1274	1281	771	824	95	4245
Black/ Clover	98	927	1799	1160	1804	387	6176
Upper Little River	0	1119	633	808	770	332	3661
Decade Total	2478	15647	23102	13787	13770	3583	72368
Percent Total	1.8%	12.0%	17.5%	10.5%	10.4%	2.7%	54.88%

Harvest during the 1960's became more dispersed and generally consisted of regeneration harvest activities, although some commercial thinning in 50 to 85 year old stands did take place. Forest programs became more intensive, incorporating site preparation, reforestation, thinning, fertilization, genetics, and pruning. Regeneration and replanting trees became the preferred method of reforestation following burning of the logging slash. Today, of the 131,853 acres in the watershed (all ownerships), a total of 75,623 acres have been regeneration harvested (Appendix C). Eventually, mid and upper slopes were roaded, gaining entry for timber harvest activities. Today, 961 miles of road exist in the Little River watershed, 630 miles of which are under government jurisdiction, including 27 miles managed and maintained by Douglas County. Roads within the Little River watershed have been developed and utilized for a multitude of uses including timber harvest, residential access, recreation, gathering special forest products, fire management and access to a variety of administrative facilities.

Harvest rates from federally managed lands have declined from 49 percent of the total harvest in Douglas County in 1985 to 33 percent in 1993. Under the Northwest Forest Plan, which amends current Umpqua National Forest and Roseburg District Bureau of Land Management (BLM) Plans, the estimated timber output for Forest Service administered lands within the Little River Adaptive Management Area for fiscal year 1996 (described in terms of Probable Sale Quantity or PSQ) is 7.5 Million Board Feet (MMBF). The Roseburg BLM has no target assigned to the

AMA, but a breakdown of Roseburg District's PSQ suggests that 4.6 MMBF is possible if managed as matrix.

Timber harvest levels in Little River are not likely to reach past levels for federally managed lands. Historically, Forest Service harvest levels in Little River ranged from an estimated 8 MMBF in the 1940s to an estimated 39 MMBF in the 1980s. BLM Little River harvest levels ranged from an estimated 127 MBF in the 1940s to an estimated 17.5 MMBF in the 1970s (Appendix D). Analyses of ecosystem processes and recommendations made by this watershed analysis will help determine the sustainable amount of timber that can be produced from public lands within the Little River watershed. On private lands, harvest rates are usually market driven; however, it can be expected that industrial forest lands, those holdings that are larger than 40 acres on average, will be managed on a 50-year rotation. Many acres of private land cut in the 1960s will likely be scheduled for harvest within the next 20 years.

Special Forest Products

Historically, little is known about the types or quantities of products (other than timber) that were collected from the Little River watershed. American Indians used many forest plants for medicinal reasons and collected food (berries, fruit, etc.) or used logs as needed. Early settlers also used the forest for many of the same purposes.

Collections on federally managed lands have been tracked since 1989. Today, products collected in the forest today include: firewood, cedar and yew posts, cedar rails, corral poles, shake bolts, beargrass, salal, sword fern, moss, incense-cedar boughs, Douglas-fir boughs, Christmas trees, sugar pine cones, and burls. Collections of beargrass, salal, and boughs have soared over the past few years. On BLM managed land alone, 118,000 pounds of beargrass was collected in 1995 by people holding permits to gather this product. See Appendix D for special forest product collections by federal agencies. Collections of special forest products will likely increase in the future and will continue to employ itinerant workers. Permit systems will continue to evolve and tracking of use is likely to improve.

Employment

Since no incorporated communities exist in the Little River watershed, it is difficult to derive estimates of historical employment levels. However, it is possible to look at Douglas County as a whole, which is representative of what has happened in and around Little River. Historically, the primary job opportunities in Little River came from the timber industry. In Douglas County, employment and income derived from timber related occupations has fluctuated over the last two decades. Periods of high unemployment have been led by job losses in the county's lumber and wood products sector. Job increases are primarily due to the large increases in service, retail, and transportation industry jobs, which typically pay less than timber industry jobs.

Despite increases in other job sectors, the timber industry still represents a significant component of the manufacturing sector for Douglas County (CCD 1994). Of all Western Oregon counties, Douglas County shows the highest portion of total personal income from the lumber and wood products sector, at around 20 percent (OED 1992a). While the timber industry continues to be important to these communities, other industries have been slowly moving in. Recreation and tourism has become a small, but important employer for the communities of Glide and Idleyld Park. A new river rafting guide service, a mountain bike shop, and several bed and breakfasts have opened along the North Umpqua River corridor to meet the needs of local people as well as those passing through. Local restaurants, gas stations, and motels also receive the benefits of the increased use of the area by recreationists. Employment opportunities in the services sector are expected to grow. As Roseburg becomes more attractive as a retirement community, the need for health, transportation, and other services will rise. Recreation and tourism demands are continuing to increase; jobs associated with these industries are also expected to increase.

Programs such as Jobs-In-The-Woods are breaking new ground to retrain forest workers for jobs that are available today and that will be available in the future. Employment trends in the timber industry are expected to fluctuate as timber becomes available for harvest on both federally managed and privately owned lands. Mechanization and improved technology will continue to influence employment levels. Use of harvest systems that are more ecologically sensitive, such as helicopter logging, will create a need for updating worker skills. Restoration projects, such as culvert repair or removal, road obliteration, and riparian and fish habitat improvement will create a small number of jobs in the future.

Recreation

Historically, recreation use followed the development of the roads. As more roads accessed the Little River watershed, new ground was opened up for fishing and hunting. In 1946, an extensive 163 mile trail system was located throughout the watershed; most likely used for accessing lookouts, other trails or road systems. The structure at Lake-in-the-Woods, built in 1909, was originally a guard station and later became a campground and recreation area. Hemlock Lake was built in 1962 to serve as a rearing pond for hatchery fish, but that idea was abandoned after it was found that temperatures were too cold in the winter for the fish to survive.

Today, the Little River watershed offers recreationists the choice of biking, picnicking, camping (Table 2), fishing, hunting, hiking, off-roading, driving for pleasure, or partaking in winter sports such as cross country skiing. On federally managed land, hiking trails and camping areas are maintained for public use. The Forest Service administers most of these sites, while the BLM manages two sites, Cavitt Falls Campground and Wolf Creek Trail. The county manages one park (Cavitt Park) in the watershed (Figure 5).

Figure 5

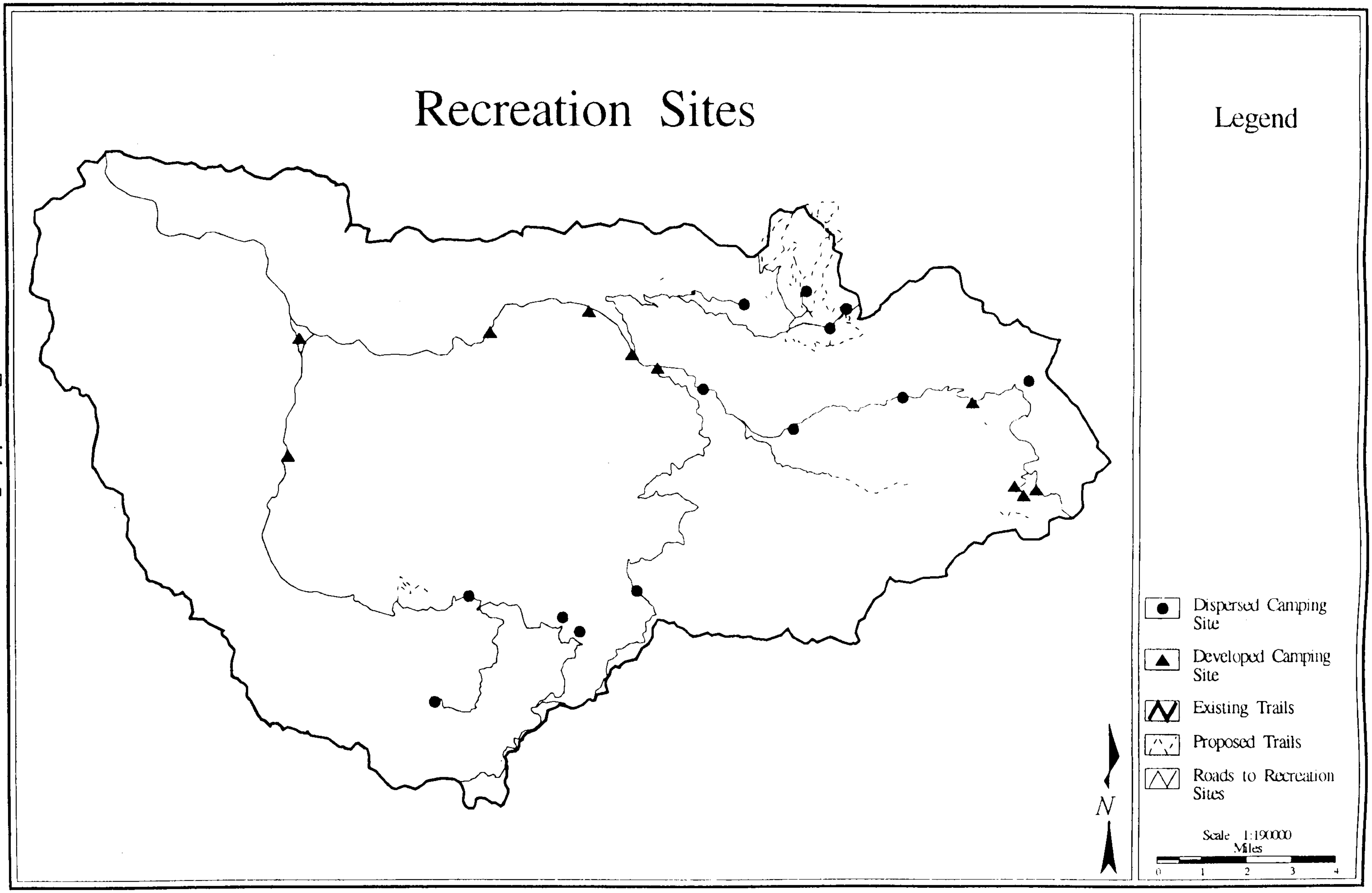

Recreation Sites
Legend
Dispersed Camping Site
Developed Camping Site
Existing Trails
Proposed Trails
Roads to Recreation Sites
Scale 1:190000
Miles
0
1
2
3
4
N

Table 2. Recreation sites, trail lengths and camping areas for federally managed lands in the Little River watershed.

Recreation Site	Miles of trail	Developed Camping	Dispersed Camping	Other
Wolf Creek Campground	N/A	Yes	No	Ball field and group area available; access to Nature Trail; Fee site
Coolwater Campground	N/A	Yes	No	
White Creek Campground	N/A	Yes	No	Access to Overhang Trail
Lake in the Woods Campground	N/A	Yes	No	Access to Hemlock Falls Trail, Hemlock Creek Trail, and Yakso Falls Trail; Fee site
Hemlock Lake Campground	N/A	Yes	No	Access to Hemlock Creek Trail, Yellow Jacket Glade Loop, Flat Rock Trail, and Snowbird Trail. Includes canoe camp
Emile Industrial Campground	N/A	Yes	No	Normally for industrial forest worker use
Cavitt Falls Campground	N/A	Yes	No	Next to waterfall
Emile Shelter	N/A	No	Yes	Primitive shelter with outhouse
Willow Flats	N/A	No	Yes	Picnic table on site
Grotto Falls	N/A	No	Yes	Picnic table on site; outhouse available; access to Grotto Falls Trail
Shadow Falls	N/A	No	Yes	Access to Shadow Falls Trail
Wolf Creek Trail	1.5	No	No	Near Wolf Creek Job Corps; leads to waterfall
Nature Trail	0.9	Next to Wolf Creek CG	No	Loop trail
Overhang	0.3	Next to White Creek CG	No	Leads to natural rock overhang
Hemlock Falls	0.5	At Lake in the Woods CG	No	Leads to 80 foot waterfall
Yakso Falls	0.7	Next to Lake in the Woods CG	No	Leads to 70 foot waterfall
Hemlock Creek	4.0	No	No	Several waterfalls along route; connects Lake in the Woods and Hemlock Lake Campgrounds

Recreation Site	Miles of trail	Developed Camping	Dispersed Camping	Other
Yellow Jacket Loop	8.0	At Hemlock Lake CG	No	Loop trail to divide between Little River and South Umpqua River
Flat Rock	0.8	Near Hemlock Lake CG	No	Vista of Hemlock Lake; old lookout location
Snowbird Trail	3.7	No	No	Accessed by Yellow Jacket Glade or at Snowbird trailhead
Big Squaw	1.5	No	No	Site of old lookout; vista of Little River and South Umpqua drainages
Grotto Falls	0.3	No	Yes	Leads to 100 foot waterfall
Shadow Falls	0.8	No	Yes	Leads to double waterfall

In general, use of these areas has increased. Campgrounds such as Cavitt Falls are experiencing the effect of overuse and limited monies for improvements. Agency budgets for maintaining hiking trails and campgrounds have also declined, making it difficult to keep up with building maintenance, annual vegetation growth, and winter blowdown along trails. User groups have shifted - now, more mountain bikers are using the trails for recreation. Much of the trail work done today is by the fire suppression crew or the Wolf Creek Job Corps.

Recreation use is expected to continue to increase in the future as more people seek outdoor experiences (SCORP 1988). Projections made (EDAW 1994) indicate that overall recreation demand and related facility needs are expected to modestly increase throughout the area, including Little River. Most demand (78%) will come from Oregon residents, while 22 percent will come from people living outside of Oregon. Activities that are expected to increase by more than 5 percent annually include day and overnight hiking, bicycling, swimming, sightseeing, boat fishing, non-motorized boating, nature study/observation, camping (RV and tent) and visits to information centers. Both current and future users will desire activities that require road access.

Areas within the watershed are sometimes used by school groups. The Little River Christian Camp, a church group retreat area, is often an overnight destination for school children and their teachers. Located along Little River and next to Wolf Creek Campground, it offers teachers and youth group leaders a place for children to learn about and experience their natural world. Since use is expected to continue, opportunities exist to enhance these learning labs by creating a center for environmental education, perhaps at Wolf Creek Job Corps, where students there can benefit from increased knowledge.

Biological and Physical Characteristics of the Terrestrial Ecosystem

There are approximately 319 vertebrate species of wildlife that can be found within the Little River watershed. Some of them are permanent residents, while some are migratory species. There are about four times as many plant species as vertebrate species, and several hundred species of invertebrates. All of these species play a part in the local ecosystem.

There is a lack of information on detailed habitat requirements for most of these plants and animals (and an equally large lack of habitat inventory information). However, we do know that animals seem to prefer certain types of habitats, climates and topography. Some animals need large amounts of dead and down wood to survive, while some need grassy open areas. Others do well in almost any situation. Wildlife habitat relationships and lists of species that utilize specific habitats in this watershed are discussed in detail in Appendix E.

Wildlife and plant populations and distribution change through time in response to habitat changes. Plants and animals that preferred late seral forests were able to maintain populations in Little River through time because large patches of habitat (missed by fire) served as refuge areas from which they could recolonize disturbed areas as they grew back into forests. Early seral species followed disturbance patterns which created openings, or used permanent openings.

Food, cover and water are the key components of wildlife habitat. Habitats such as riparian areas often provide all of these. In addition, many species utilize special habitats such as rock outcrops, and wet or dry openings for breeding or feeding purposes.

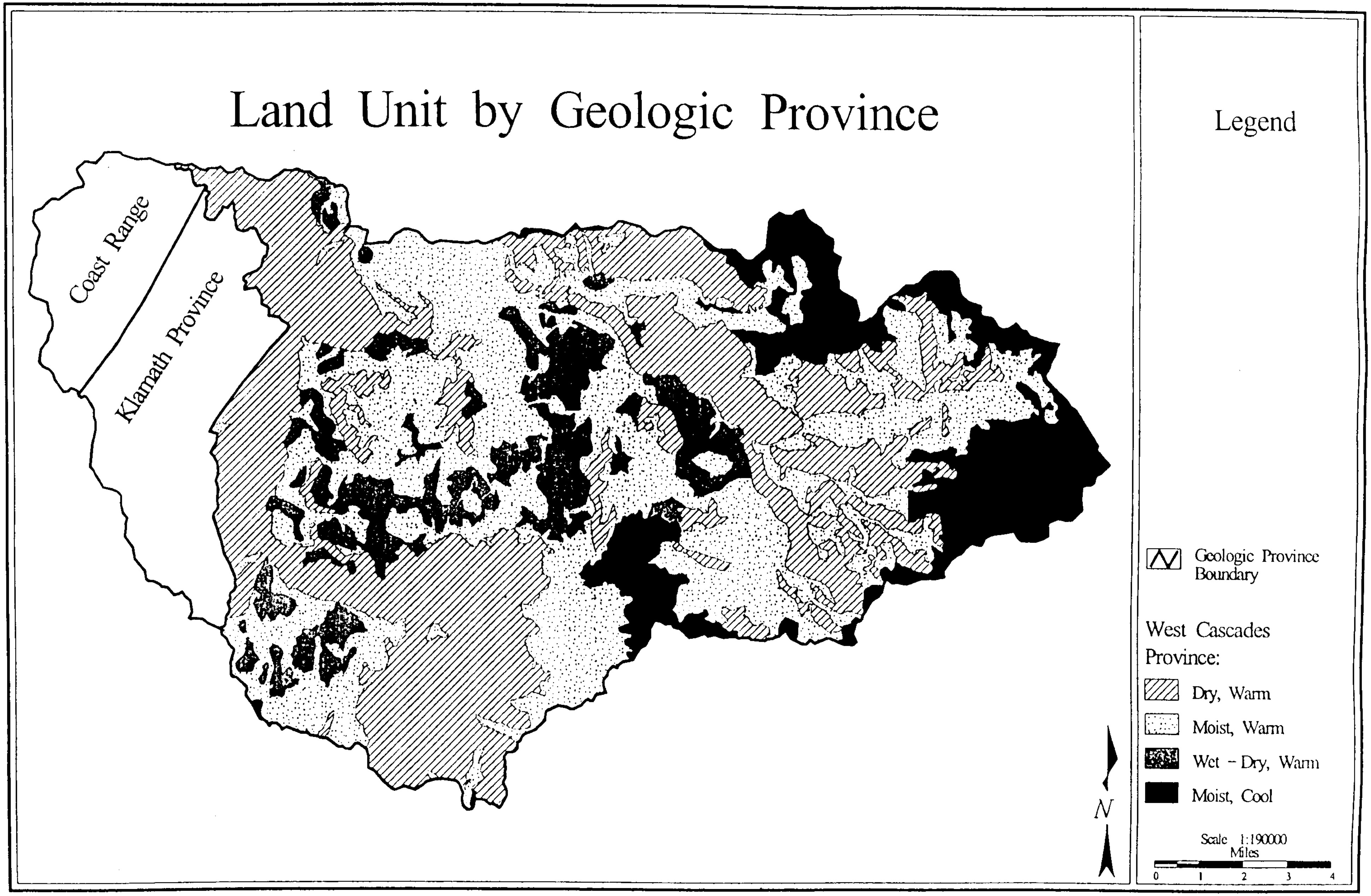
Stratification of the Watershed

Land units of the Little River watershed

The following land unit descriptions of Little River were developed as a framework to describe how landform, climate, vegetation, and disturbance interact in shaping aquatic and terrestrial ecosystems at the coarsest scale (see Appendix J for an in-depth discussion on how land units were developed). Four broad land units (dry/warm, moist/warm, wet-dry/warm, and moist/cool) were delineated for the Western Cascades geologic provinces (which contains the majority of the public land found in Little River) based on differences in landform and climate (Figure 6). Some Bureau of Land Management (BLM) administered lands are located in the Klamath province, while no public land is found in the Coast Range province. The development of these land units, described in the At-A-Glance section on pages 15-23, was based on the following concepts:

1) Landform and climate control the location and extent of disturbance and produce predictable patterns in vegetation and stream conditions (Swanson et. al. 1990).

Figure 6


Land Unit by Geologic Province
Coast Range
Klamath Province
N
Legend
Geologic Province Boundary
West Cascades Province:
Dry, Warm
Moist, Warm
Wet - Dry, Warm
Moist, Cool
Scale 1:190000
Miles
0 1 2 3 4

2) The interactions between the forest and streams differ in response to disturbance history, plant succession and geomorphic setting (Swanson et. al. 1990).

3) Patterns in a landscape are easier to observe than ecosystem processes, so an understanding of how landscape patterns affect processes such as fire behavior, erosion, and streamflow will allow one to predict ecosystem behavior in response to change (Swanson 1988).

The purpose of dividing the Little River watershed into land units is to encourage land managers and resource specialists to view the watershed at a broader scale and in a way that will help focus on the processes that formed the land; processes that are the basis for how the watershed "works" (Little Applegate WA 1995).

Since each land unit is mapped in similar geologic and climatic environments, the large-scale patterns created by vegetation development and land-forming processes within each land unit should be similar. Land units were used in describing the important forest and stream-forming processes operating in the Little River landscape. They are also used as a framework for developing vegetation and watershed management strategies.

The reference source for the historical pattern of vegetation was from 1946 aerial photographs. Recent changes in landscape patterns are evaluated by comparing the recent vegetation patterns and stream conditions.

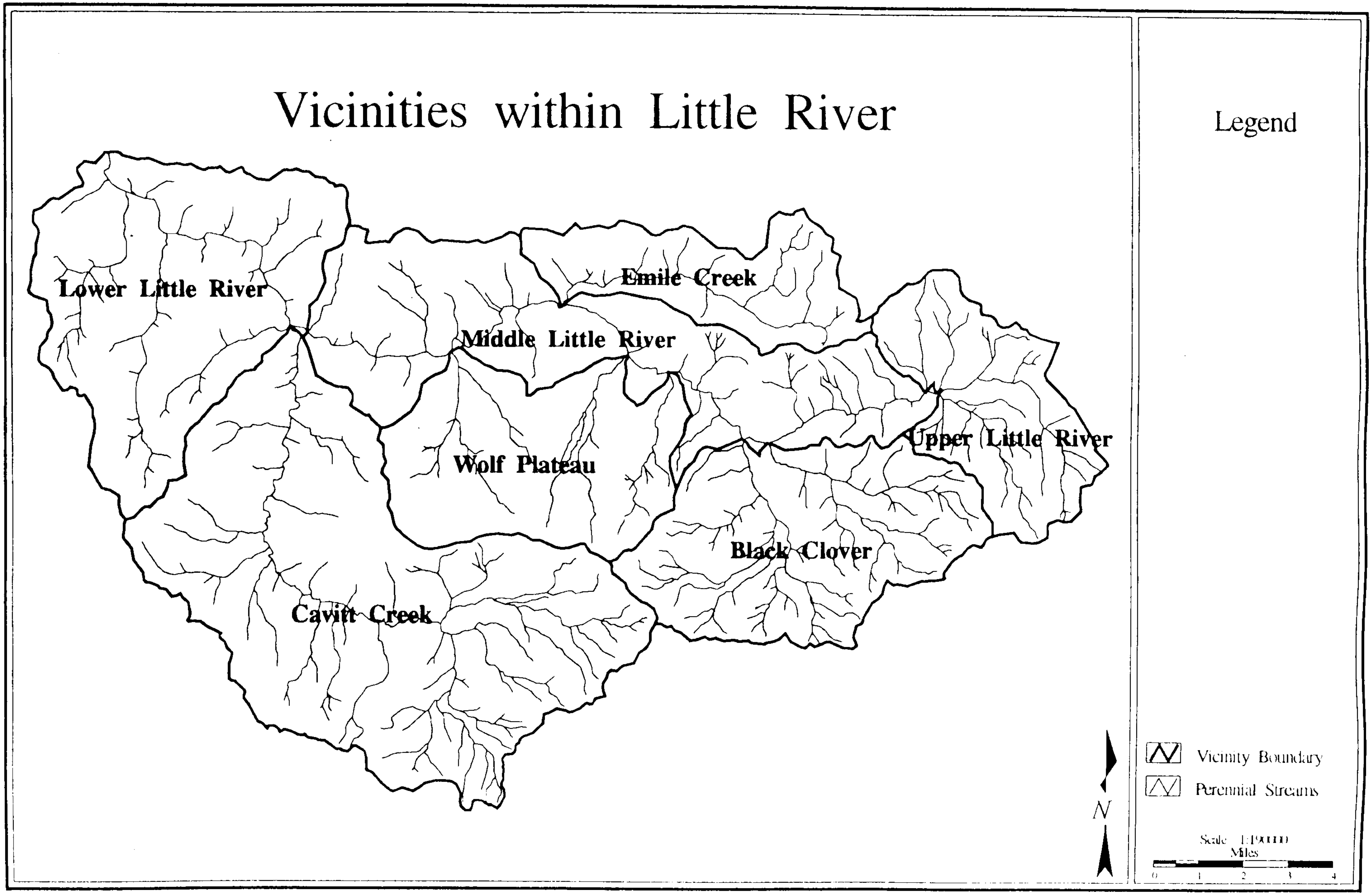
Vicinities

The watershed was divided into seven vicinities for the purpose of grouping areas with similar land unit composition, elevation range, and topography. Vicinity boundaries (Figure 7) were based on subwatershed boundaries (ridges). They are useful as planning areas that are smaller than the entire Little River watershed, and have a more homogeneous ownership pattern.

These vicinities also provided stratification to conduct a landscape pattern analysis. This is because they are single contiguous blocks of land contained within definable watershed boundaries. The landscape patterns within them result from the underlying land units, topography and ownership. To conduct only one landscape pattern analysis on the entire Little River watershed would have been less precise because patterns in the western portion are much different from patterns in the eastern margins. Current land patterns also differ from east to west. Vicinity level landscape pattern analysis and analysis of watershed conditions was found to be useful for conducting a watershed analysis of this size. Using two stratifications (land units and vicinities), helps integrate the effects of terrestrial and aquatic processes. For example, differences in land unit patterns by vicinities may explain the differences in the condition and extent of aquatic habitat in those vicinities.

Characteristics of each Western Cascades land unit (dry/warm, moist/warm, wet-dry/warm, and moist/cool) are displayed in the Land Unit At-a-Glance.

Figure 7



Vicinities within Little River
Lower Little River
Emile Creek
Middle Little River
Wolf Plateau
Upper Little River
Black Clover
Cavitt Creek
N
Legend
Vicinity Boundary
Perennial Streams
Scale 1:190000
Miles
0
1
2
3
4

Land Unit At-a-Glance

Legend

= Douglas-fir

= white fir

= western hemlock

= western redcedar

= hardwoods

= shrubs/forbs

= deep soils

= shallow soils

= variable depth soils

= high intensity fire

= moderate intensity fire

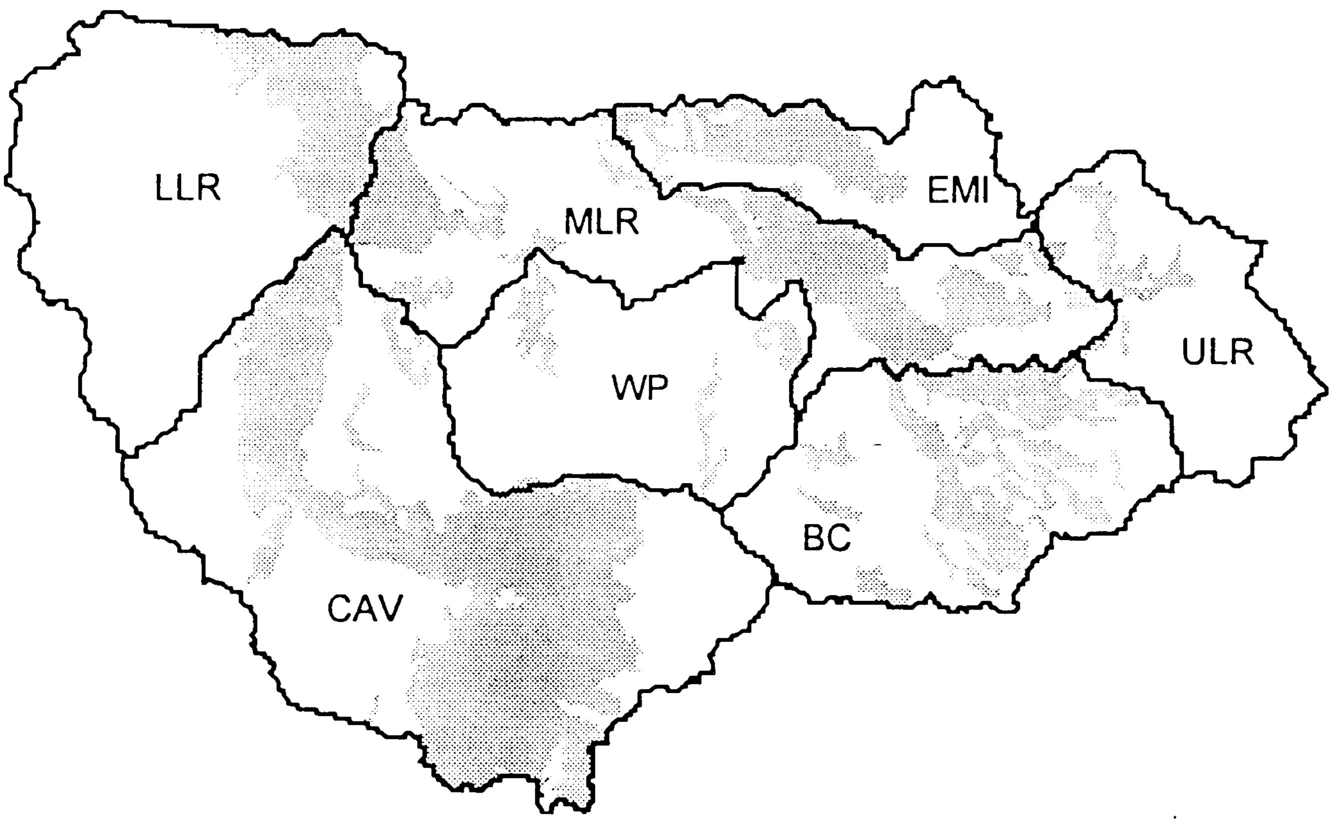
= low intensity fire

= rain

= snow

Land Unit At-a-Glance

Dry/Warm Western Cascades

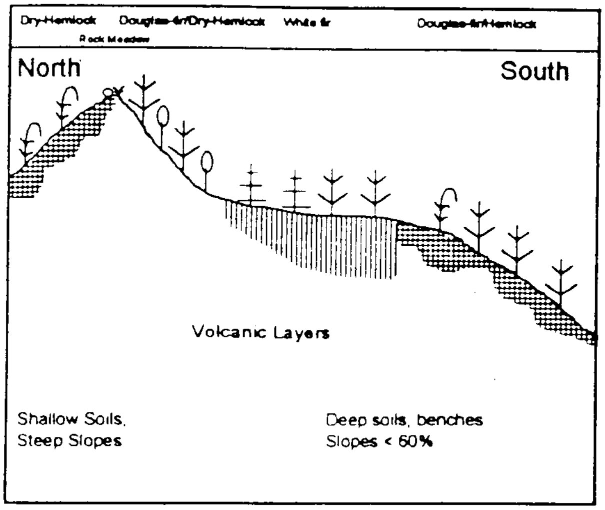


Percent of Dry/Warm Land Unit in Each Vicinity

Lower Little River (LLR)	17%	Wolf Plateau (WP)	10%
Middle Little River (MLR)	37%	Black/Clover (BC)	33%
Emile Creek (EMI)	33%	Upper Little River (ULR)	10%
Cavitt Creek (CAV)	47%		

Dry/Warm Western Cascades

PHYSICAL FEATURES



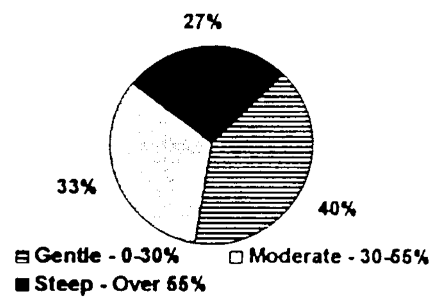
Conceptual Cross-Section

Elevation Range: 1,600 to 4,000 ft

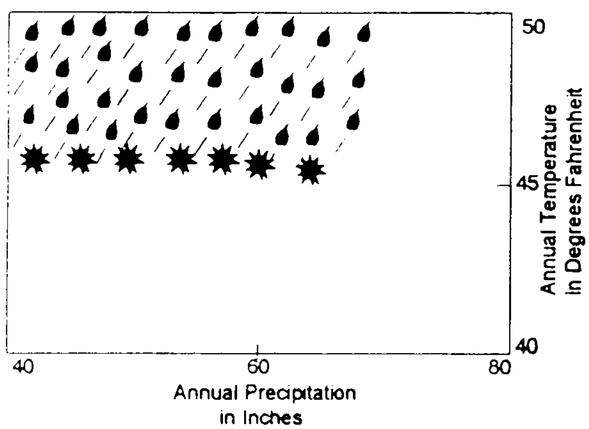
Landforms: Dissected uplands, landslide complex, upland plateau

Soils: Shallow on steep slopes, deep on gentle south slopes

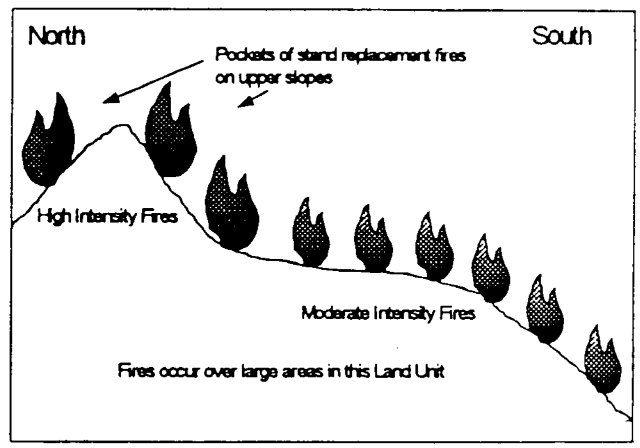
Slope Class



CLIMATE

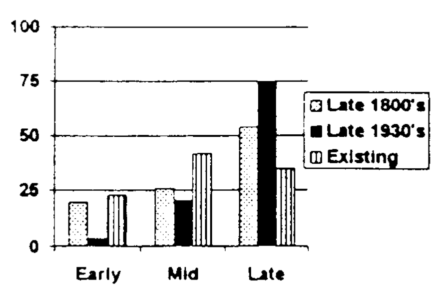


DISTURBANCE



VEGETATION

Percentage of Seral Stage in Land Unit
Reference and Existing Vegetation



UNIQUE HABITATS

*This land unit contained the greatest number of natural openings and the second highest density at 8.3 natural openings/mi^2. Openings are relatively static due to thin soils and poor growing conditions for trees.

*Opening size:

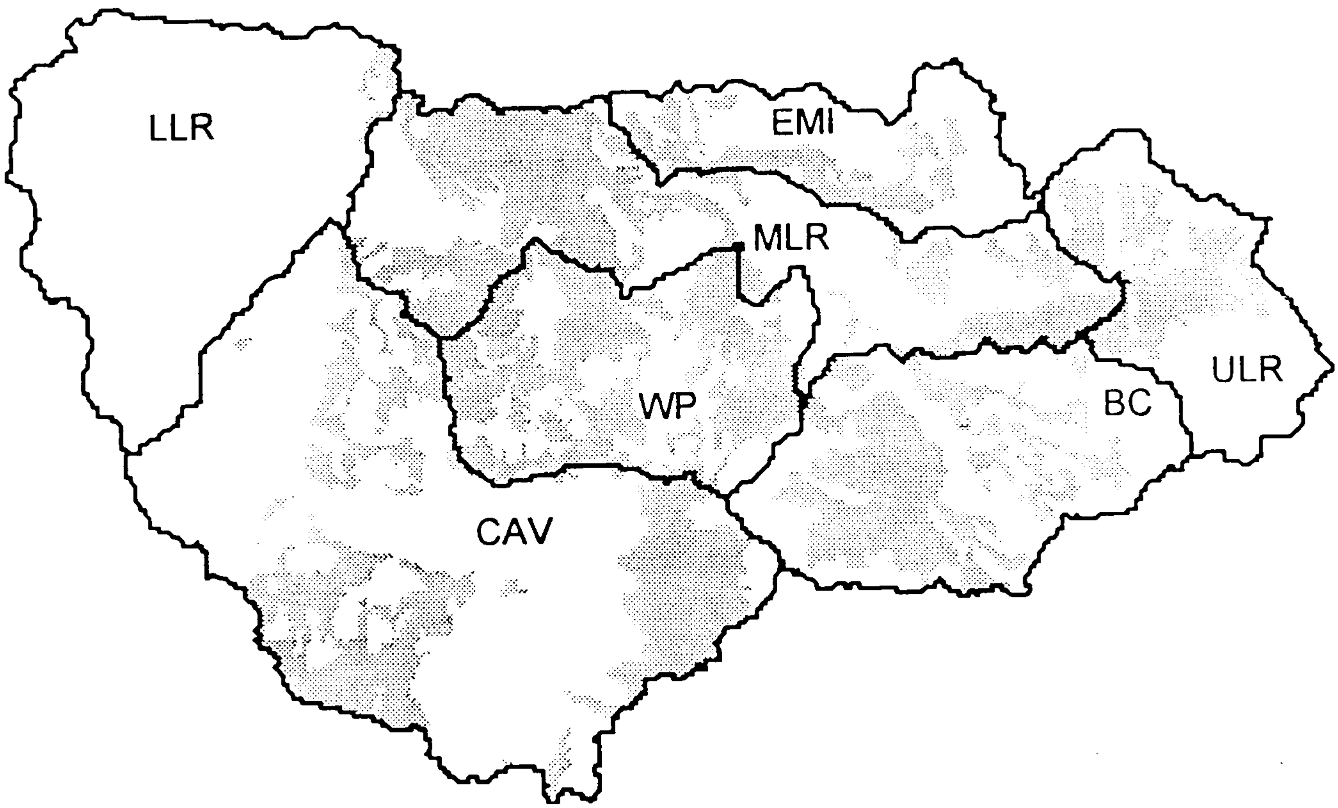
0.2 ac min ——— 71 ac max

Mean = 2.5 ac

*Openings usually occur on the upper slopes and ridges and are on dry, shallow rocky soils and rock outcrops.

Land Unit At-a-Glance

Moist/Warm Western Cascades

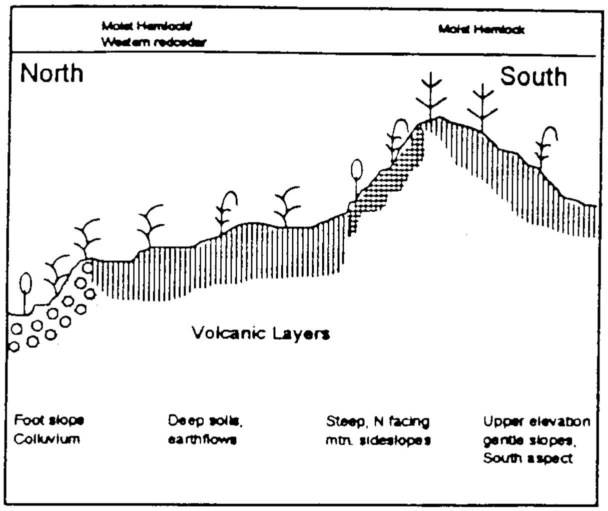


Percent of Moist/Warm Land Unit in Each Vicinity

Lower Little River (LLR)	1.4%	Wolf Plateau (WP)	57%
Middle Little River (MLR)	47%	Black/Clover (BC)	42%
Emile Creek (EMI)	28%	Upper Little River (ULR)	32%
Cavitt Creek (CAV)	30%		

Moist/Warm Western Cascades

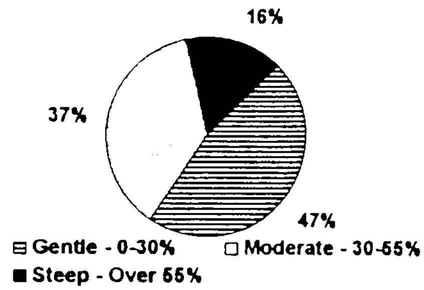
PHYSICAL FEATURES



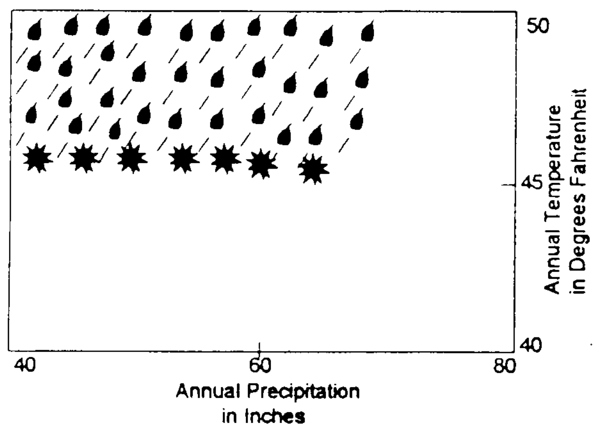
Conceptual Cross-Section

Elevation Range: 850 to 4,200 ft
Landforms: Dissected upland, upland plateau, landslide complex, earthflow
Soils: Deep

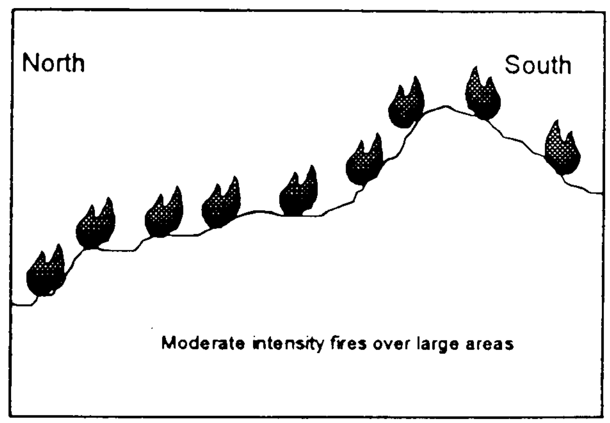
Slope Class



CLIMATE

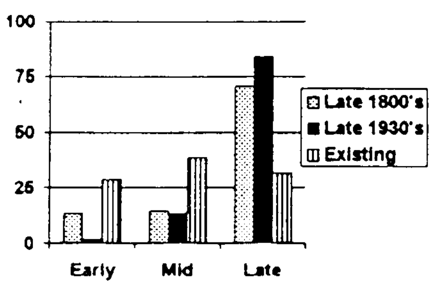


DISTURBANCE



VEGETATION

Percentage of Seral Stage in Land Unit
Reference and Existing Vegetation



UNIQUE HABITATS

*Contains primarily of seasonally wet openings with some perennial wet meadows. Some drier openings occur on steep slopes. Opening density = 4/mi^2.

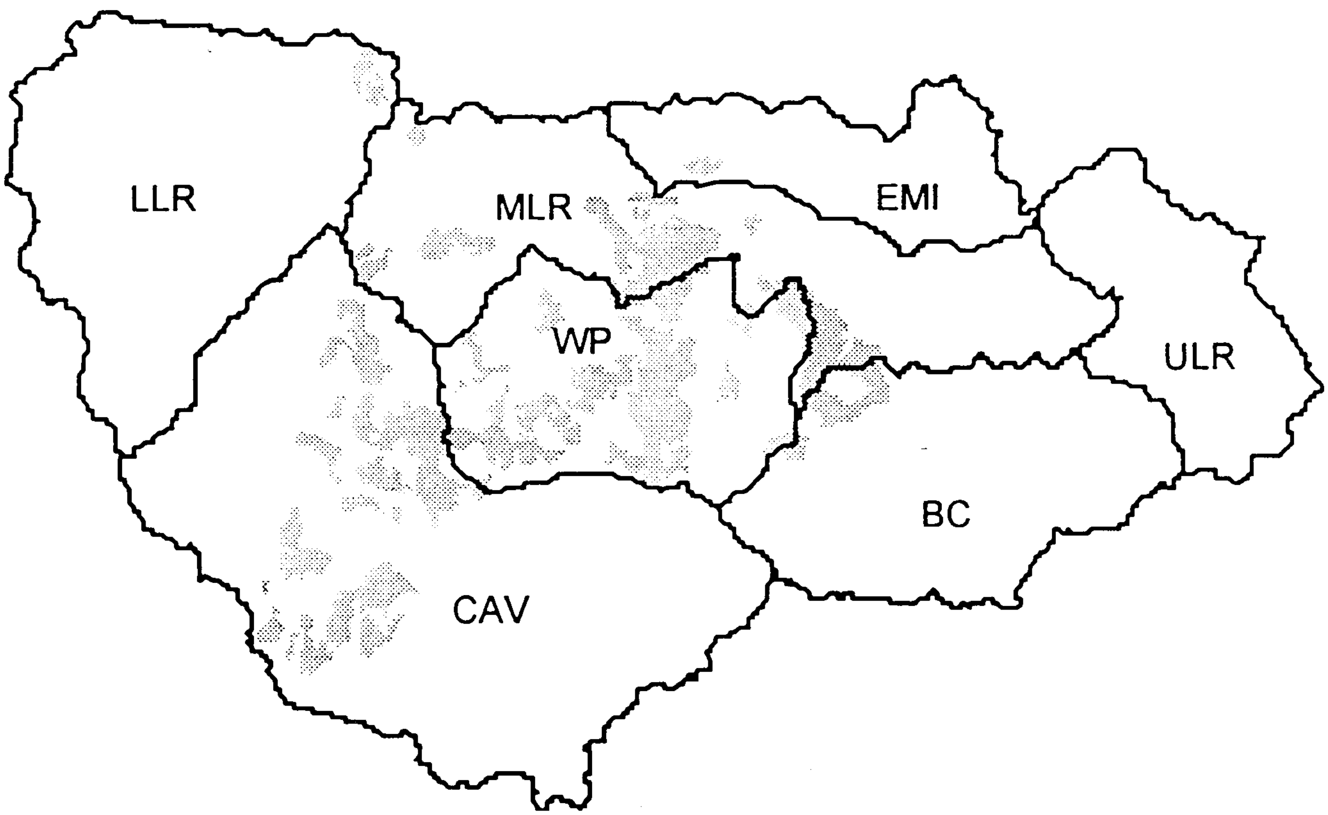
*Opening size:

0.2 ac min — 27 ac max

Mean = 1.8 ac

*Favorable growing conditions result in rapid encroachment by trees and shrubs.

Land Unit At-a-Glance
Wet-Dry/Warm Western Cascades

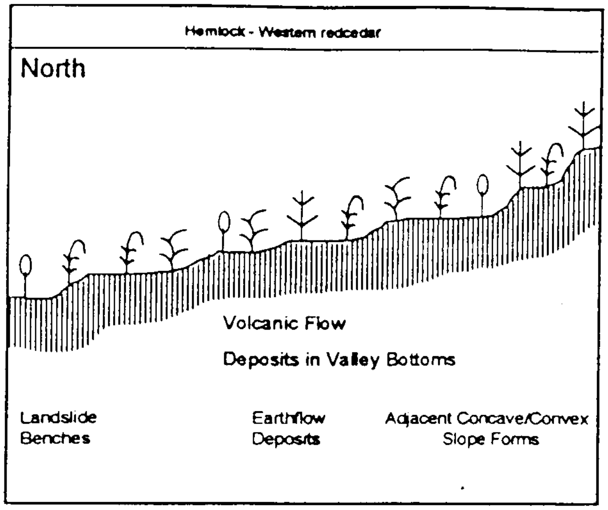


Percent of Wet-Dry/Warm Land Unit in Each Vicinity

Lower Little River (LLR)	1%	Wolf Plateau (WP)	30%
Middle Little River (MLR)	13%	Black/Clover(BC)	3.5%
Emile Creek (EMI)	1%	Upper Little River (ULR)	0%
Cavitt Creek (CAV)	11%		

Wet-Dry/Warm Western Cascades

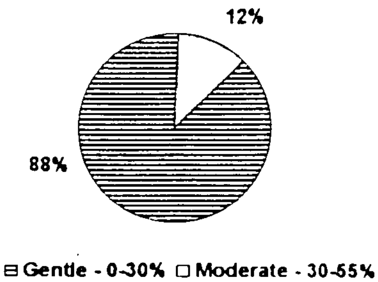
PHYSICAL FEATURES



Conceptual Cross-Section

Elevation Range: 1,000 to 3,000 ft
Landforms: Earthflow, landslide complex
Soils: Deep

Slope Class



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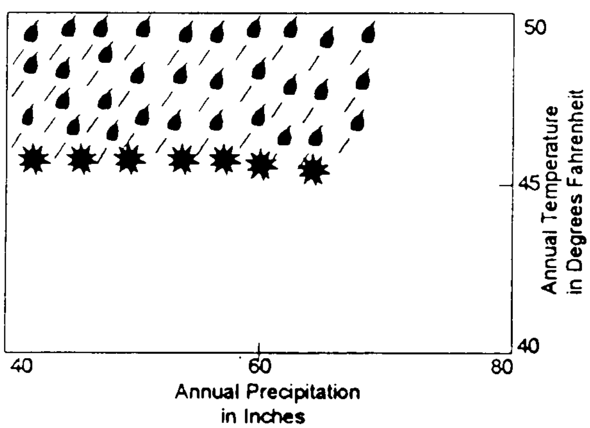
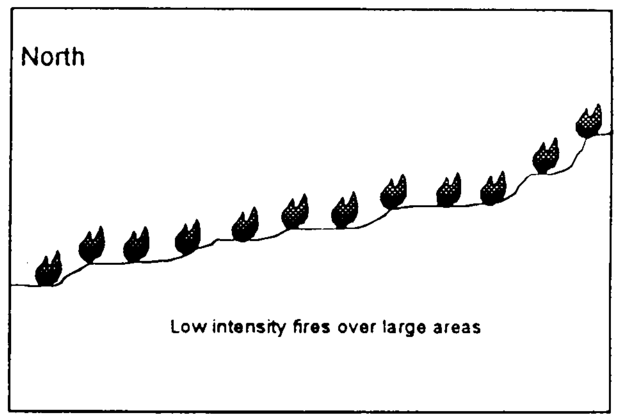
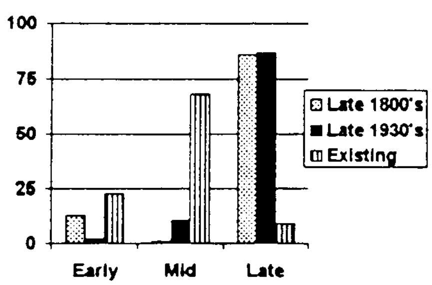


DISTURBANCE



VEGETATION

Percentage of Seral Stage in Land Unit
Reference and Existing Vegetation



UNIQUE HABITATS

*Historically, this land unit contained the fewest number and lowest density of openings.

*Opening size:

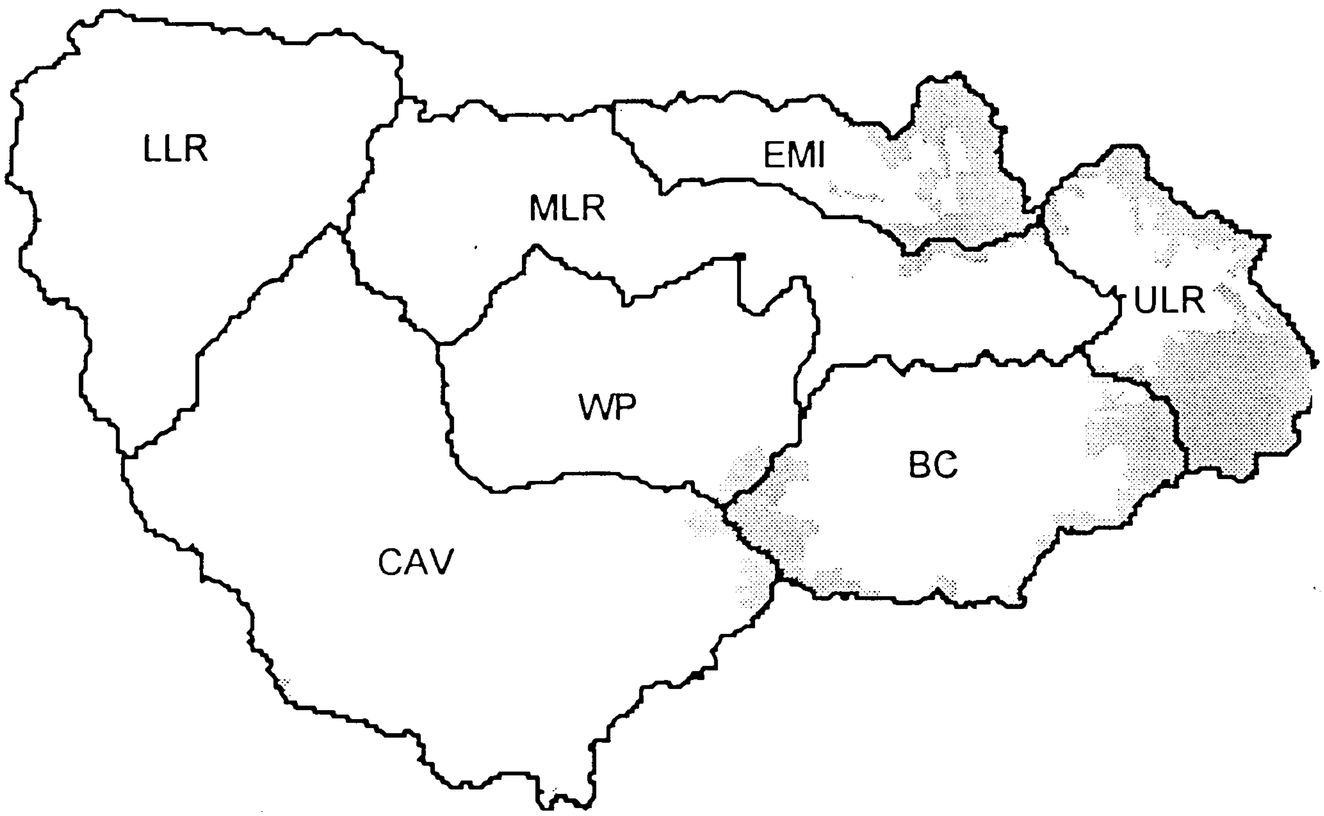
0.2 ac min — 34 ac max

Mean = 2.7ac

*Openings usually occur on steeper slopes and in areas with land movement.

Land Unit At-a-Glance

Moist/Cool Western Cascades

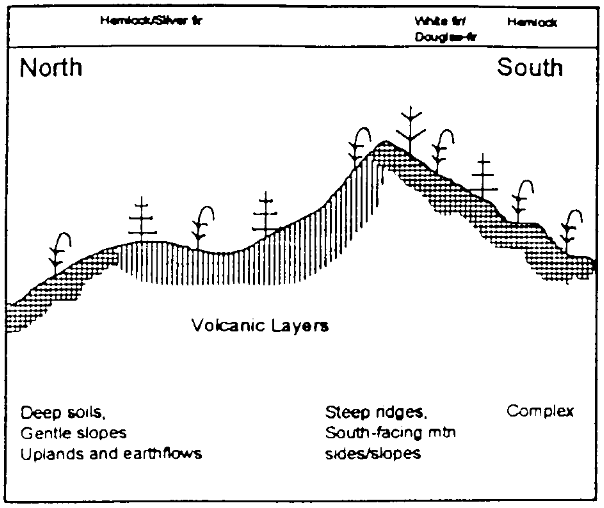


Percent of Moist/Cool Land Unit in Each Vicinity

Lower Little River (LLR)	0%	Wolf Plateau (WP)	2.8%
Middle Little River (MLR)	13%	Black/Clover (BC)	3.5%
Emile Creek (EMI)	1%	Upper Little River (ULR)	58%
Cavitt Creek (CAV)	2%		

Moist/Cool Western Cascades

PHYSICAL FEATURES



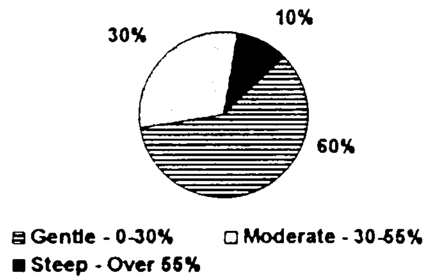
Conceptual Cross-Section

Elevation Range: 3,200 to 4,700 ft

Landforms: Upland plateau, dissected uplands, earthflow

Soils: Mostly deep

Slope Class



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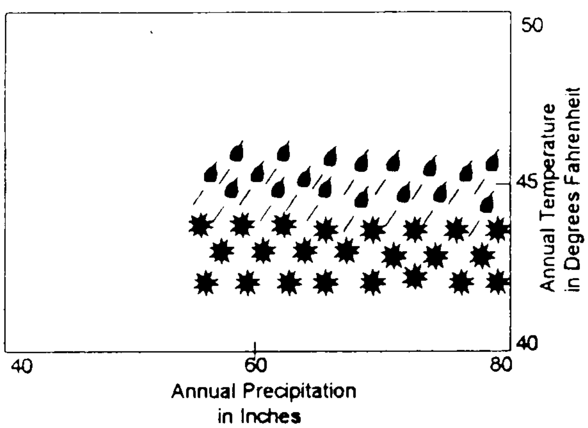
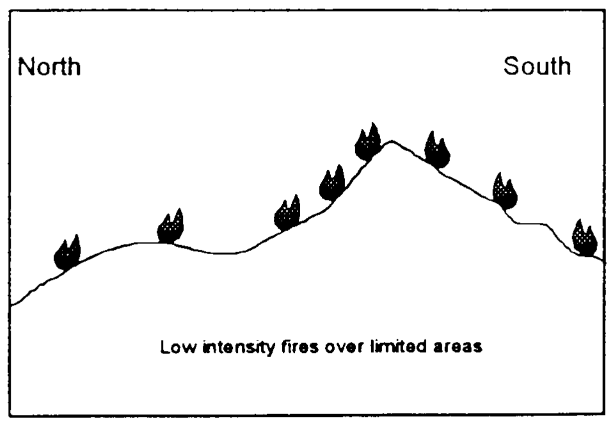
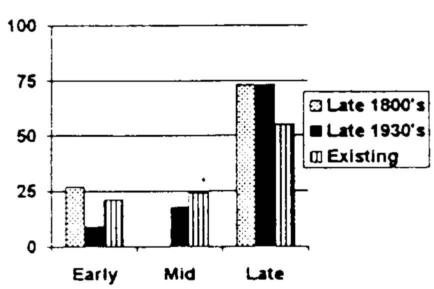


DISTURBANCE



VEGETATION

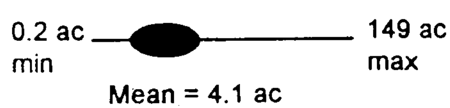
Percentage of Seral Stage in Land Unit
Reference and Existing Vegetation



UNIQUE HABITATS

*Highest density of openings at 15.5/mi^2, these tend to be large and static, due to high water tables and short growing seasons.

*Opening size:



*Openings mostly consist of wet meadows, bogs, and marshes which are located in riparian zones on gentle to moderately sloped ground.

Physical Features

The geology found throughout the Little River watershed is a result of ancient plate tectonic processes (shifts in the earth's crust) that have shaped the North American continent for the past hundred million plus years. Eighty-three percent of the watershed area has a foundation of volcanic rocks, while the rest of the watershed (the westernmost and privately owned portion) has a diverse assemblage of underlying rocks that include sediments, siltstones, sandstones (all in the Coast Range province), greenstones, and serpentines (Klamath Mountain province). Many different types of volcanic rocks that erupted from volcanic domes, vents, or fissures, are found within the watershed, including tuffs, breccias, andesites, and basalts (See Appendix A for a detailed discussion on geology).

Landforms are features on the landscape created by the effects of erosional processes and different weathering rates of rock types. Several types of landforms are present within the Little River watershed (Figure 8):

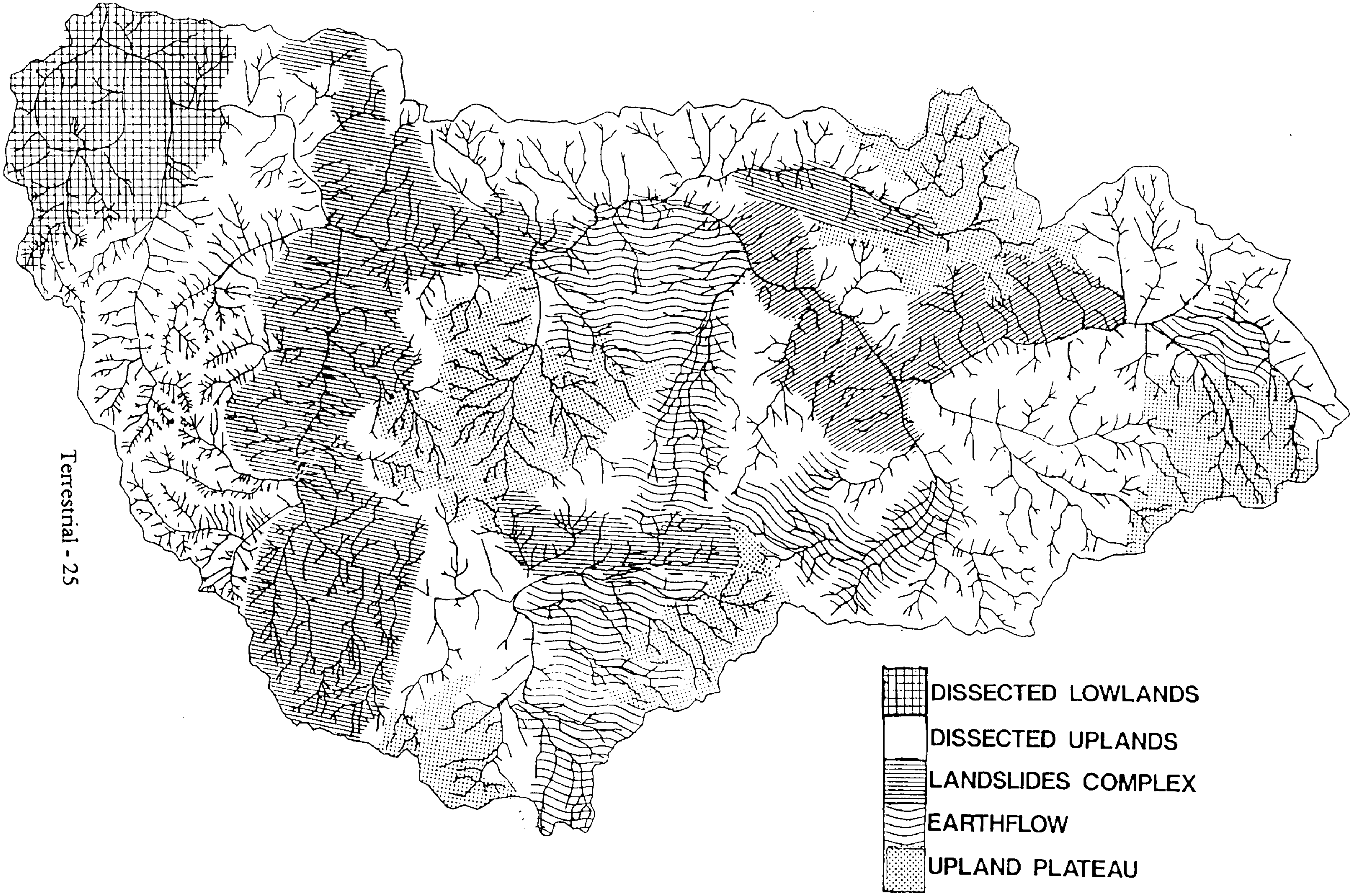
Dissected Lowlands are smooth, convex slope forms on mostly gentle slopes at low elevations found in the Coast Range and Klamath Mountain provinces. Here, erosion has reduced the mountains to hills and broad valleys that are filled with sediment. Channel gradients are low and have meandering stream courses that are indicative of a landscape that has been subject to intense weathering and erosion for a very long time.

Dissected Uplands are smooth, concave slope forms on mostly steep slopes in the Klamath Mountain and Western Cascades provinces. The ridges of these land forms are narrow and slopes are steep from ridgetop to canyon bottom. Channel gradients are steep with narrow, confined, bedrock dominated channels. High densities of streams are found where runoff is rapid from the steep slopes and shallow soiled areas.

Landslide Complexes are complex slope forms that have a mixture of steep and gentle slopes. This topography has been created by the downslope movement and break-up of large, landslide blocks (10's to 100's of acres in size) in the canyons of Cavitt Creek and Little River. When looking at a profile of a landslide complex, the terrain is stair-stepped, with gentle benches and steep slopes on scarps (the "scar" left by a landslide) between landslide blocks and other landforms. Channel gradients are variable. On steeper gradients, gullies have formed with steep side slopes along the channel. On low gradients, streams form a meandering course. Earthflow deposits are a common inclusion on gentle slopes in landslide complexes where weak, clay-rich rocks and abundant water cause the earth to move.

Figure 8

Landforms of Little River



Earthflows are irregular, broken, hummocky valley-bottom deposits on gentle slopes. On a small scale, earthflows are a mixture of concave and convex slope forms. The broken character of the terrain has caused the drainage network to be poorly defined with ponds and seeps common where water comes to the surface on gentle slopes. Subsurface water flow is significantly greater than that of surface flow. Surface drainage networks are often confined along the margins of the earthflow deposit and have formed gullies with steep side slopes in response to being pushed aside by the earthflow deposit.

Upland Plateau's are elevated, gently-sloping, smooth land surfaces near the top of the watershed where erosion has done the least amount of work. Thousand foot-thick rocks resistant to erosion have preserved these gentle surfaces in an otherwise highly dissected and eroded landscape. Stream gradients and stream densities are low.

Disturbance

Historically, lightning caused wildfire was the main disturbance process in Little River. Burning by American Indians and settlers also occurred in Little River up until the late 1800s. Indians probably set fires around their summer camps in the upper watershed and in the low elevation hills adjacent to winter villages. Since the late 1940s, fire suppression, timber harvest, and the lack of prescribed fire in unmanaged stands has influenced how fire interacts with the landscape. Insects, disease, and windthrow are disturbance processes that all function at a smaller scale than fire, providing pockets of disturbance at the stand level. These disturbance processes, working simultaneously, determine landscape vegetative patterns, and have influenced wildlife populations and aquatic habitat for centuries.

Reference Condition Fire Behavior and Land Units

The path over which a fire travels depends on several variables. In normal weather conditions, weather, topography, and fuel factors effect how a fire behaves. Weather is the variable that changes the most, affecting fire intensity and rate of spread. South and west aspects usually experience higher fire intensity (faster rates of spread, greater flame lengths, and increased fire intensity). Since these aspects receive more sunlight for longer periods of time, they tend to be drier and warmer than north or east aspects. Slope steepness has a tremendous influence on fire behavior. Increasing slope steepness increases the rate of spread due to preheating of available fuels; flame lengths can also increase. Finally, fuel factors such as the type and size of vegetation, its moisture content, and how it is arranged on the ground, directly affect the way a fire burns. The more fuel available to burn, the greater the fire intensity and the more severe the fires effects will be.

In the following discussion fire severity will describe cumulative fire effects in the growing environment. General terms such as high, moderate and low summarize fire effects.

Fire intensity is used to generalize fire behavior elements such as rate of spread, flame lengths and fire line intensity (BTU/ft/s). It is difficult to quantify these specific elements at the landscape scale; high, moderate and low intensity terms are used to describe the reference conditions interaction with fire.

There is a strong correlation between fire behavior and the previously described land units. The majority of the public land in Little River falls into the four land units in the Western Cascade Geologic province. This land unit stratification is critical to understanding how fire interacted with the landscape in the past, as well as how changes to the landscape (through management activities) have altered the future risk of fire in the Little River landscape.

Moist/cool land units receive the greatest amount of precipitation (up to 80 inches per year), have slopes of gentle to moderate steepness, and experience infrequent, low intensity, small acreage fires. Only in extreme weather conditions would a high intensity, stand replacement fire occur in the moist/cool zone. Forests in this land unit show an old-growth structure: multiple layers, shade tolerant species in the understory, large wood on the ground, etc. Cool air temperatures and high humidity often exist in moist/cool forests during any season. When fires do ignite in this land unit, they would thin out fire intolerant understory species, but would have little effect on the overstory. An example of interaction between land units would be Peter Paul Prairie. The prairie is in the moist/cool land unit. However its juxtaposition to the dry/warm land unit allows fire to interact more readily than on other moist/cool sites. The openings such as Peter Paul Prairie, Yellow Jacket Glade and Willow Flats are not solely dependant on fire for maintenance as open areas. High water tables and soil type play an important role in maintaining these sites. Tree encroachment is a slow process in the moist/cool land unit. When moist/cool land units are adjacent to dry/warm land units, a large amount of edge is created due to fire.

Wet-dry/warm land units receive approximately 65 inches of precipitation per year and have mostly gentle slopes. This land unit experiences low intensity fires that cover large areas. Decomposition rates are rapid and the accumulation of organic matter in the soil is high. The drier forests in this land unit (where fire would tend to burn with higher intensities) are simple in structure, usually two layered, and have fire tolerant species in both the understory and overstory. The wetter forests would act as fire breaks, slowing fire spread or containing the fire. Stand structure in wetter forest resembles forests in the moist/cool land unit. This combination provides for mosaic stand in both structure and composition.

Moist/warm land units also receive approximately 65 inches of precipitation per year, but have gentle, moderate, and steep slopes. These highly productive sites have the ability to produce and accumulate fuel quickly, resulting in frequent, low to moderate intensity fires that shape the forest, which has a single or two-storied structure. Fire tolerant species are present in the overstory, while shade tolerant species occur in the understory between fire events. As slope steepness increases, mortality in the overstory and openings (gaps) occur more frequently. The maintenance of openings are dependent on growth rates and intervening disturbances. The mature successional stage is prolonged due to frequent moderate severity fire. This is an area to focus on for fuel accumulation outside of the natural range due to productive growth rates.

Dry/warm land units receive about 60 inches of precipitation per year. Productivity can be limited by low soil moisture in the later half of the growing season; little large wood or leaf litter accumulates in these sites. Duff thickness and organic matter available for incorporation into the soils is generally limited. Gentle, moderate, and steep slopes occur in this land unit, with over half of the slopes in the moderate or steep category. When ignitions occur (which they do frequently), the likely result is a moderate severity fire that covers a large area. Historically, fire intensity in this land unit was directly related to slope steepness and weather since available fuels were limited. Pockets of stand replacement fire associated with moderate severity fire would occur in the upper slope position. This is evident by numerous openings on steep slopes in the upper slope position in the dry/warm land unit on the 1946 aerial photos. Stands move through the stages of succession rather slowly due to site conditions and frequent fires. Typical stand structure would be even aged, and would be frequently subject to stand replacement fires, especially on upper slopes. Both the understory and overstory have a hardwood component in them, with fire tolerant species present in the overstory. Species not adapted to fire would be present only in riparian areas and on lower portions of the slopes.

In order to characterize the historical extent and ecological role of fire in the Little River watershed, two different methods were used.

For low to moderate intensity fires, a fire history field inventory was conducted. This inventory examined 3,258 stumps from trees harvested in the last 10 years over a variety of elevations and aspects in the watershed. Random samples of the Forest Service managed public lands were surveyed. Low to moderate intensity ground fires leave the overstory trees alive, while leaving fire scars near the base of the live trees that tell the story of how often and where these ground fires burned. For an explanation of the fire history survey methods, see Appendix B.

The fire history surveys determined that 54 percent of all stumps showed some degree of disturbance, indicated by a scar or pitch ring. Surveyors were able to establish a reference period for low to moderate intensity fires that spanned from the years 1613 to 1938. The number of fire scars dropped off dramatically after 1938, so the end of the reference condition was established at 1938. During this 325 year period, the cumulative mean fire return interval (the average time between fire events in a particular area) for the area was thirteen years. The range was nine to seventeen years. This is a very frequent fire return interval, when compared to areas in the northern and central parts of the Cascade Mountain Range. Calculation information is in Appendix B.

For stand replacement fires, aerial photos taken in 1946 were analyzed to characterize the extent and role of these high intensity fires that killed entire stands of trees. These stand replacement fires were visible on the photos as even aged stands which burned prior to 1946. For severe fires, the aerial photos showed that up to 21 percent of the Little River watershed was burned by stand replacement fires within approximately a 200 year period.

Fire Regime: The fire regime of an area is a function of the growing environment (temperature and moisture patterns), its ignition patterns, and the characteristics of the plant species present, including fuel accumulations and adaptations to fire (Agee 1990). Based on analysis of the fire history data and the 1946 aerial photos, Little River can be classified as having a **moderate severity fire regime** for the reference condition. A moderate severity fire regime is one of the most difficult to describe. Fire frequencies usually range from 20-100 years and individual fires often show a range of effects. The overall effect is one of patchiness at the landscape level and at the stand level, two or more age classes would be present (Agee 1990). Fires covered large areas, were of a variety of intensities, and burned often. Fires of low to moderate intensities were the norm, with pockets of stand replacement activity that created mosaic patterns of vegetation on the landscape. A fire regime covers a large area (in this case 132,000 acres). While the land units experience different intensities of fire at varying frequencies however, the overall regime for the reference condition includes all land units.

Existing Condition

Fire suppression was established with the Forest Reserves in 1906. Fighting fires became more effective with the advent of the Civilian Conservation Corps (1929), smoke jumpers (1940), lookouts (1930-1950), and improved communications. Today, aerial retardant, helicopter delivery of water and people, educational prevention programs, 800 miles of open roads, fire engine capabilities, plus well trained and equipped firefighters have all increased the ability to extinguish fires within the first 24 hours of their detection. Extreme weather and multiple starts in combination with delays in initial attack are what allows fires to escape under today's condition. In the western United States today, 97 percent of all fires are contained to less than 1/4 acre; the other 3 percent make the headlines.

Fire suppression efforts of the past have not been offset by the use of prescribed fire, diminishing the natural effects of fire in the watershed. The ecological role of fire has been substantially diminished and is often not considered as a management tool. Today, timber harvesting represents the greatest source of disturbance found in the watershed. With about 60 percent of the watershed harvested since the 1940s, fuel types and amounts have changed radically from historic conditions. Ninety percent of these harvested acres have received some sort of fuels treatment, either broadcast or hand-pile burning. Regardless of treatment, stand structures have been altered and stand densities have changed. Today's current stands are more dense. The exclusion of fire has not allowed forest understory densities to be kept in check as in the reference condition. As stand densities increase, the amount of available fuels increase, resulting in fire behavior that has higher intensities, even in normal weather conditions. This is especially true for over 7,000 acres of the dry/warm land unit, which have tree densities that are much higher than what naturally occurred. A fire started in the dry/warm land unit would more likely have a higher fire intensity and fire severity than what was experienced in the reference condition due to increased fuel loads.

Air Quality

Please see Appendix B for a discussion on air quality.

Fuel Models

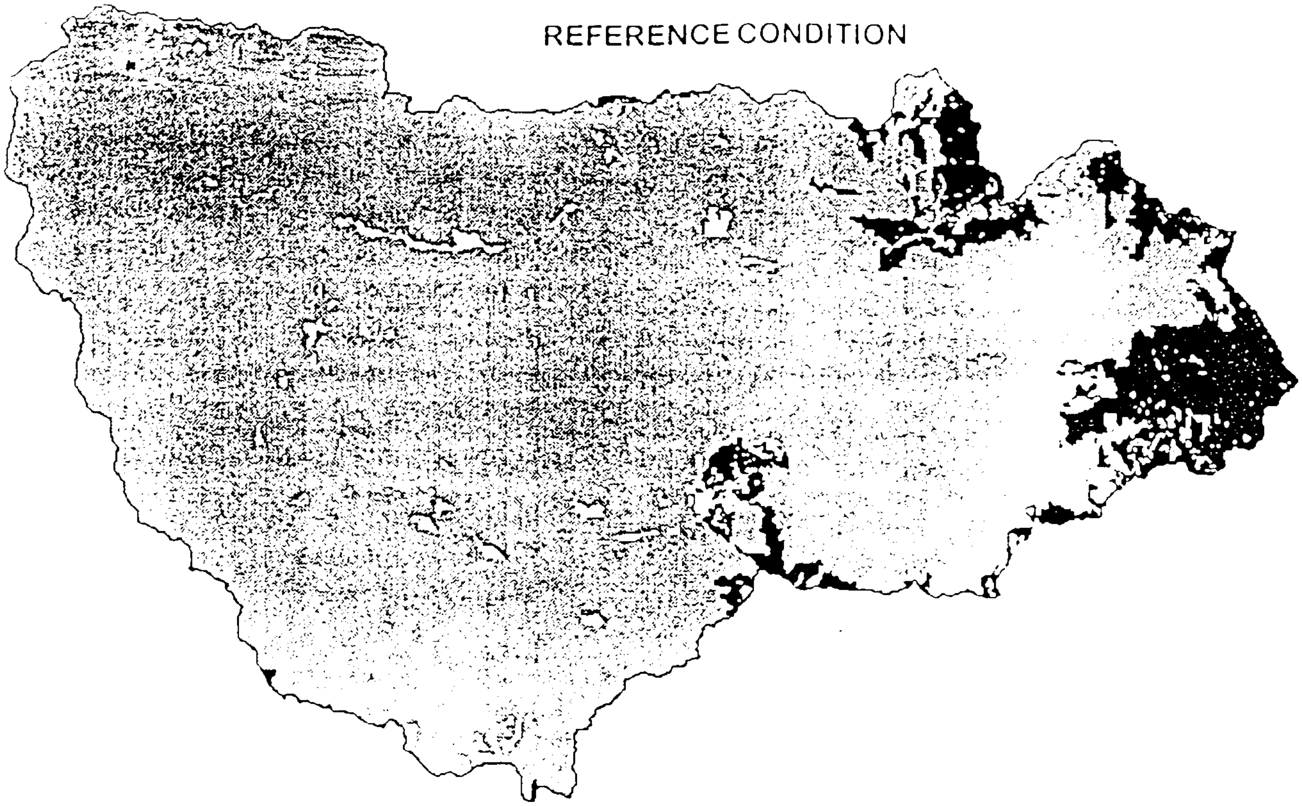
Fuel models have been designed to quantify the flammability of forest stands. In order to make fire behavior predictions, fuel models are assigned to stands. These models focus on the small size class fuel loads associated with certain vegetation. The small size class fuels are quantified since they are the main fire carriers (Appendix B). The determination of representative fuel models focuses on the expected fire behavior.

The fuel model that covered the most acres of Little River's forests during the reference period was a fuel model 8 (Figure 9). This fuel model characterizes fire behavior in mature and old-growth stands with light fuel loads. The fire intensity typically associated with fuel model 8 is low in normal weather conditions. Normal weather conditions in this case are measured in wind speeds and fuel moisture content of the dead and down wood. Weather that is normal would have wind speeds at or above 9 mph and dead fuel moisture content above 11 percent in the large wood (ninetieth percentile weather). Stands with a fuel model 8 condition that experienced fire had relatively low mortality in the overstory and a moderate to high mortality of understory shade tolerant trees and shrubs. This resulted in a relatively simple stand structure with two age classes and open understory conditions. Moderate severity fire dominated in all land units throughout the watershed, although moist/cool land units had limited interaction with fire. Moist/cool land units would serve as fire breaks or contained the fire because of its associated cool air temperatures and high humidities. The findings of the fire history inventory support the predictions of the fuel modeling exercise for the reference condition. Today's fuel models are different than in the reference condition.

Today's potential for rapidly moving and hotter burning fires has increased over the reference condition. Fuel models with the highest hazard are 9 and 10. In some vicinities, tens of thousands of acres are in a higher risk category than they were in the past (Table 3). Generally, future fires will have higher flame lengths, greater rates of spread, and will have more severe effects on vegetation, soil, and aquatic habitat. These elements of fire behavior will be present even in normal summer weather conditions and intensify during extreme weather conditions (drought, high wind, etc.).

FIGURE 9 FIRE BEHAVIOR FUEL MODELS

REFERENCE CONDITION



EXISTING CONDITION

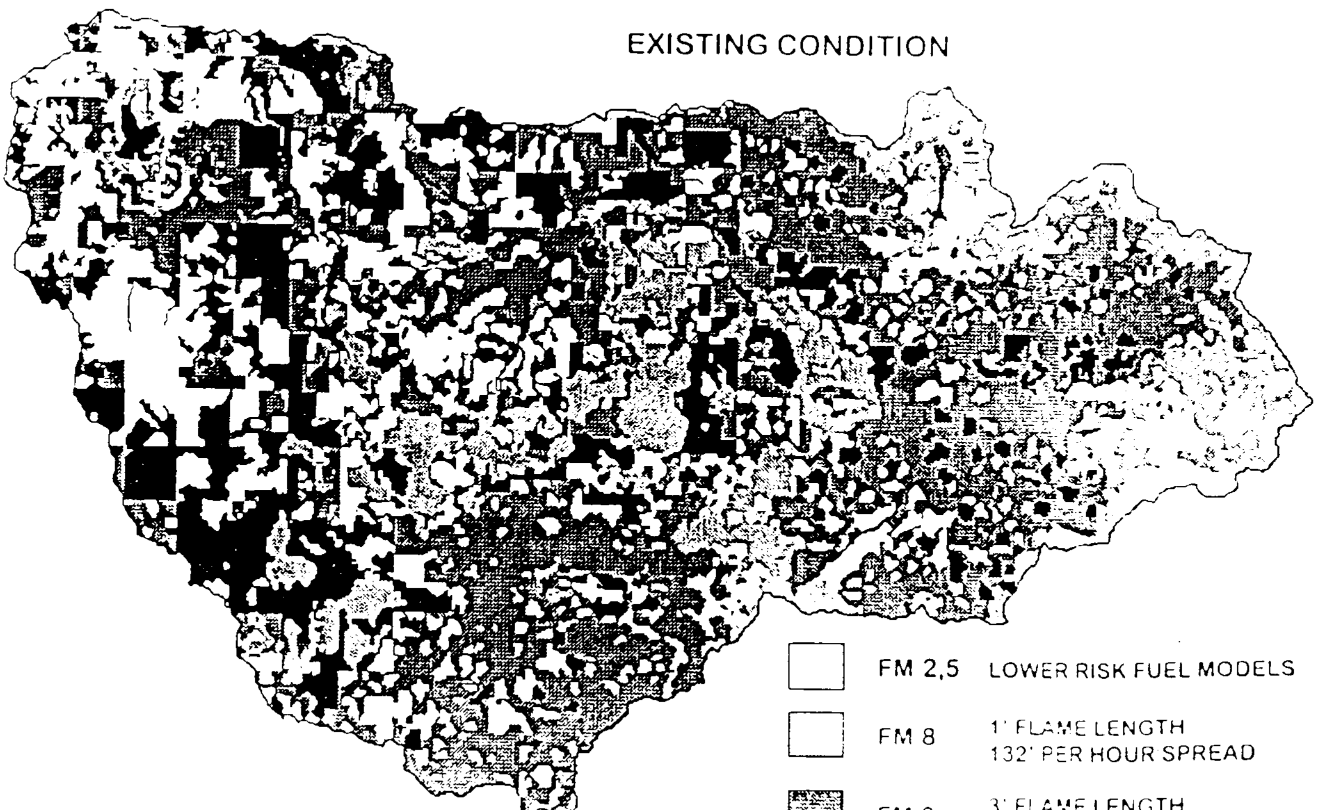


Table 3. Proportions of high hazard fuel conditions in the vicinities of Little River, past and present.

Vicinity	Acres In Vicinity	Acres And Percent Of Vicinity In High Hazard Fuel Categories: Historic Condition	Acres And Percent Of Vicinity In High Hazard Fuel Categories: Current Condition
Lower Little River	21,835	0	11,482 (53%)
Cavitt Creek	37,689	1,884 (5%)	25,628 (68%)
Middle Little River	21,632	4,326 (20%)	15,141 (70%)
Wolf Plateau	14,514	2,902 (20%)	8,126 (56%)
Emile Creek	8,718	1,482 (17%)	5,578 (64%)
Black/Clover	17,057	1,876 (11%)	11,662 (68%)
Upper Little River	10,408	5,600 (54%)	5,203 (50%)
Totals	131,853	18,070 (14%)	82,820 (63%)

Many of the unmanaged stands that have been deprived of fire are in fuel model 9 today (see Appendix B). These are moving toward fuel model 10 with more dead and down material on the forest floor and an intermediate layer of live fuel. The end result of the trend toward a more severe fire regime will be greater mortality in stands that experience fire. The environmental effects of fire will be more destructive and the cost to suppress fires will increase.

Fires of this magnitude and intensity have occurred in the recent past. In 1987, the Clover fire burned over 2200 acres in the Black/Clover vicinity and the Fall Creek fire burned 5,000 acres in the Cavitt Creek vicinity which includes the highly erosive granitic terrain. The Clover fire was a typical moderate intensity fire that burned the landscape in a mosaic pattern, with stand replacement pockets. The Fall Creek fire was more intense, burning as a stand replacement fire in a landscape dominated by plantations. Both these fires covered large areas due to the combined effects of drought, multiple starts, limited fire fighting resources, and stand conditions.

Today there is a trend toward a **low frequency, high severity fire regime**, which is characterized as a severe surface or crown fire that results in total tree mortality. Fires of this extent are usually associated with drought years, east winds, and dry lightning storms. Fire return intervals are long and may not be cyclic. The role fire has in this system is an agent of ecosystem instability, as it creates major shifts in forest structure and function (Agee 1990). This trend is of most concern in the dry/warm land unit. The fuel conditions in Little River are not in a state of extreme hazard as they are in the forests of eastern Oregon. However, fuel loads are on a trend to becoming well above normal levels in Little River. Stand conditions present today are a precursor to heavier fuel loads.

Many private, industrial forest lands within the watershed are likely to be scheduled for harvest over the next 20 years. A trend towards increased fire hazard on private lands can be expected at least for the next two decades depending on the pattern and type of harvest treatment applied. In addition, the Cavitt Creek and Little River vicinities are experiencing a gradual trend of increased human population, so the interface with rural landowners and fire hazard may intensify.

Fire Occurrence Rates

A fire occurrence rate is predicted by determining the number of fire starts in a particular area for a certain time period then averaging these starts out to an annual occurrence rate. For example, if 100 fires were started in a 20 year period, the annual occurrence rate would be 100/20 = 5 starts per year. The occurrence map for Little River with high, moderate and low zones is in Appendix B. Since we are unable to predict where and when a fire (especially one caused by lightning) will occur, it is helpful to examine fire records over a larger area in order to get a picture of how fire interacts with the landscape. To estimate the probability of large fires occurring in the watershed in the future, past fire records (of lightning caused fires) of the entire 250,000 acre North Umpqua Ranger District were examined for the time period of 1983 to 1992. This time period was chosen because it had a variety of fire sizes, providing a good reference of how fires burned historically. Probability estimates were made (Table 4) for two time frames, a 50 year period, to get a sense for immediate concerns, and a 120 year period, to help predict what may occur in the long term, even with fire suppression effort in place.

Table 4. Probability of fires occurring and the acres likely to burn in 50 and 120 years.

Acres Likely To Burn	Probability of Occurrence Within the Next 50 Years	Probability of Occurrence Within the Next 120 Years
16,500	.012%	100%
66,000	.012%	.20%
132,000	.012%	.20%

Occurrence rates for the private and BLM managed lands were unavailable, so utilizing only Forest Service data provides an underestimate of the acres likely to burn in the watershed. Regardless, this conservative estimate predicts that 16,500 acres will burn in the watershed over the next 120 year period. While current fire occurrence rates are probably very similar to historic rates, the area affected by these fires today has been held to a minimum.

Insects

Several insect species have caused substantial amounts of mortality throughout southwest Oregon, including Little River. Found in endemic populations in Little River, mountain pine beetles have caused mortality in sugar pine and western white pine. Like other bark beetles (at endemic populations), mountain pine beetles rarely infest healthy vigorous trees. Rather, they prefer (or are most successful on) trees that are under some degree of stress, induced by competition, drought, disease or wounds. In Little River (and in SW Oregon), beetles are attacking healthy-appearing pines in heavily stocked stands where competition for water is weakening trees (Goheen 1995). Additionally, overstocking of stands that include sugar pine is stressing these trees, making these areas susceptible to beetle infestations, fire and/or windthrow.

In addition to the mountain pine beetle, both the western and pine engraver beetles have the potential to cause extensive mortality in ponderosa pines in the Little River watershed. As with sugar pine, overstocking in ponderosa pine stands will predispose the area to attack by these insects.

Douglas-fir beetles are present in the Little River watershed, but have not significantly effected forests in the area. Areas that have experienced recent windthrow are very susceptible to infestations of Douglas-fir beetles. Once an infestation begins, these beetles have the capability to attack live, standing trees, causing patches of mortality (Goheen 1995).

Diseases

White pine blister rust causes substantial damage to five-needle pines (sugar pine and western white pine) in southwest Oregon and is common in the Little River watershed. The complex life cycle of this disease makes it difficult to control. When outbreaks do occur, trees branches are killed or are weakened and become susceptible to attack by mountain pine beetles, again creating gaps in forest stands.

Laminated root rot is another disease found in the Little River watershed. Although only found in less than 1 percent of the area in the watershed, laminated root rot is a long-term disease, lasting 50 years or more in the roots of infected snags and stumps, making it difficult to re-establish a coniferous forest on affected sites. Openings created by laminated root rot can be beneficial as they often provide areas of species diversity and groups of dead and down trees (Goheen 1995).

Black stain root disease, common in southwest Oregon Douglas-fir plantations, has caused little mortality in Little River, but opportunities exist for this disease to take hold and spread. Areas with compacted soils or wounded trees appear to be especially vulnerable to attack (Goheen 1995).

Stem decays in conifers are another cause of disturbance in the watershed. Hemlocks and true firs are particularly susceptible to stem decays. Long rotations are difficult to attain in these forests due to the presence of these stem decays - stem breakage can be quite common. Found throughout the watershed, stem decays cause small-scale disturbances and are not in epidemic proportions. However, little documentation exists on how stem decays develop in intensively managed Douglas-fir plantations (especially those treated with heavy machinery), which are in abundance in the Little River watershed (Goheen 1995).

Finally, hemlock dwarf mistletoe is found throughout the watershed. This disease primarily affects western hemlock, although true firs are also hosts on occasion. Impacts to trees can be light to severe, with stem malformation, branch dieback, and tree mortality as the end result. Malformations, called "brooms", can be desirable as nest platforms for some species of wildlife. Hemlock dwarf mistletoe can cause significant problems, especially where regeneration of hemlock is important.

All of the insects and diseases present in the Little River watershed are found in endemic (normal and cyclic) proportions, primarily causing small-scale disturbances. It is expected that most insects and diseases will remain at current populations. Only in the case of the mountain pine beetle is there a cause for concern. Populations of mountain pine beetle can be expected to increase if competition and understory densities are not reduced in sugar pine stands.

Refer to Appendix B for a more thorough discussion on insects and diseases.

Forest Productivity and Species Diversity

Introduction

In Little River, disturbance events, such as fire, determine vegetative patterns across the landscape. These disturbance events, combined with soil moisture, temperature, and geology determine the plant communities that occur throughout Little River.

Forests in the Pacific Northwest are inherently productive. Evergreen conifers and high productivities are a result of the relatively dry, cool summers and warm winters that characterize the Douglas-fir region (Waring and Franklin 1977). Site productivity is the ability of a geographic area to produce biomass (organic matter such as trees and wildlife) as determined by conditions (such as soil type and depth, rainfall, and temperature) in that area (FEMAT 1993). For this analysis, site productivity is further defined in terms of the production of commodities such as merchantable timber.

As part of the Northwest Forest Plan, the emphasis of the Little River Adaptive Management Area (the public land portion of the watershed) is the "development and testing of approaches to integration of intensive timber production with restoration and maintenance of high quality riparian habitat." Intensive timber production efforts require knowledge of the resources tied to tree growth and the condition of the commercial land designated for timber harvest.

Understanding the current processes and conditions of the forests and streams in Little River will help determine the ability to balance intensive timber production with the need to maintain and restore high quality riparian habitat.

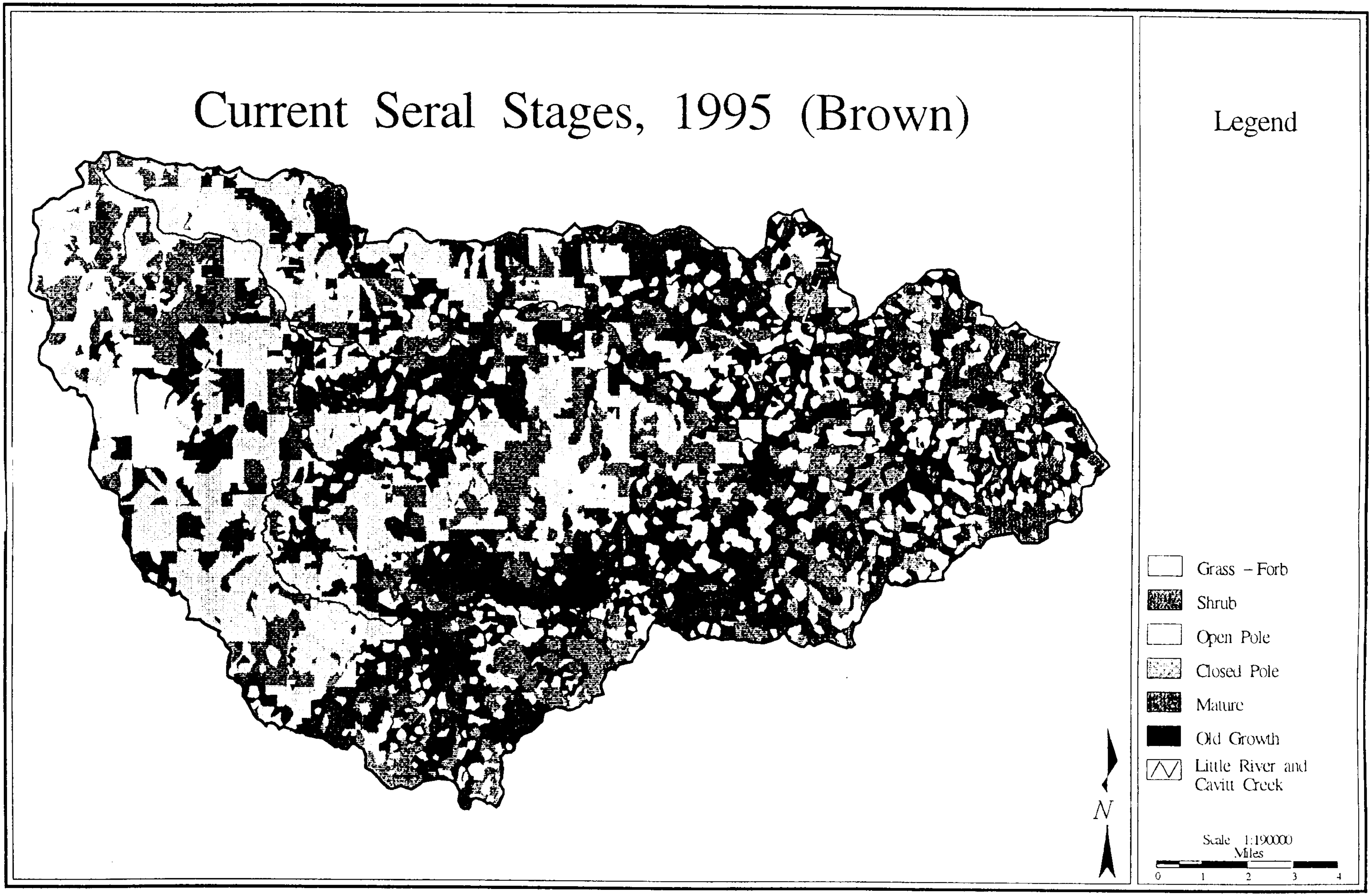
Site productivity in young managed stands (those stands cut prior to 1970 for the purpose of this analysis) can be affected by management activities that affect soil quality such as tractor logging (which can cause compaction), the treatment used to reduce fuels (such as broadcast burning), and the amount of large wood left on site after harvest. In addition, site productivity (for the production of commodities) can be affected by competition for nutrients, light and water caused by high stand densities. Finally, site productivity can be measured in terms of the time it takes for a tree to reach breast height and by assigning the area a site index.

In mature stands, productivity can be affected by competition for nutrients, light, and water from the understory that grows up underneath the large trees (ingrowth). Productivity can also be influenced when thinning treatments are applied to a stand.

Diverse and complex groups of species exist in Little River. Ecologists have developed a way to combine the various types of vegetation into recognizable groups, referred to as plant associations. Plant associations are described by herb, shrub, and tree species on the basis of the likelihood that a particular tree species will become climax given a period of stability (relatively free from disturbance). In older stands, a climax species shows dominance on a particular site and is usually able to regenerate itself in perpetuity. Included in this species diversity discussion is the presence of rare plants and the use of native plants for revegetation efforts. Another important component of species diversity include the presence of exotic species that can displace native species.

The process of succession has a continuous effect on species diversity. To describe the process of forest succession in Little River, six categories were delineated (Brown 1985), called seral stages (Figure 10): 1) the grass/forb stage for pioneering plants and seedling establishment; 2) the shrub/seedling/sapling stage for rapid and diverse plant establishment which often creates valuable forage for wildlife species; 3) the open sapling/pole stage, where young coniferous trees fill in most of the growing spaces, forage opportunities become more limited, and hiding cover begins to be available; 4) the closed pole/sapling stage where tree crowns close in, creating unfavorable growing conditions for most understory species due to low light levels, but creating more hiding cover for many game species; 5) the mature forest stage, where tree mortality through self-thinning increases, height growth slows down, and the understory begins to develop again as openings are created; and 6) the old-growth stage, where diversity is increased through the formation of gaps and re-initiation of understory growth, and large woody debris and snags become more abundant. These six seral stages were grouped into three broad categories: 1) early-seral, which combines the grass/forb and shrub/seedling/sapling stages; 2) mid-seral, which combines the open sapling/pole and closed sapling/pole stages; and 3) late-seral, which combines the mature forest and old-growth stages.

Figure 10



Current Seral Stages, 1995 (Brown)
Legend
Grass – Forb
Shrub
Open Pole
Closed Pole
Mature
Old Growth
Little River and Cavitt Creek
N
Scale 1:190000
Miles
0 1 2 3 4

Seral stages change as forests move through succession following a disturbance event. Where fire functioned as the primary disturbance agent in the past, timber harvesting has assumed that role today. The seral stages present today in the land units of Little River have changed from the reference points of the past (Figure 11). There has been a substantial shift in landscape patterns toward one dominated by early and mid seral forests today, compared to two historic reference points where older forests dominated (See Appendix C, maps 2-4). The most dramatic shift in seral stages has occurred in the moist/warm and wet-dry/warm land units. Historically, these land units sustained the old-growth forests over long periods. They were also the first places where intensive timber harvest occurred due to their gentle terrain, accessibility, and high timber volumes.

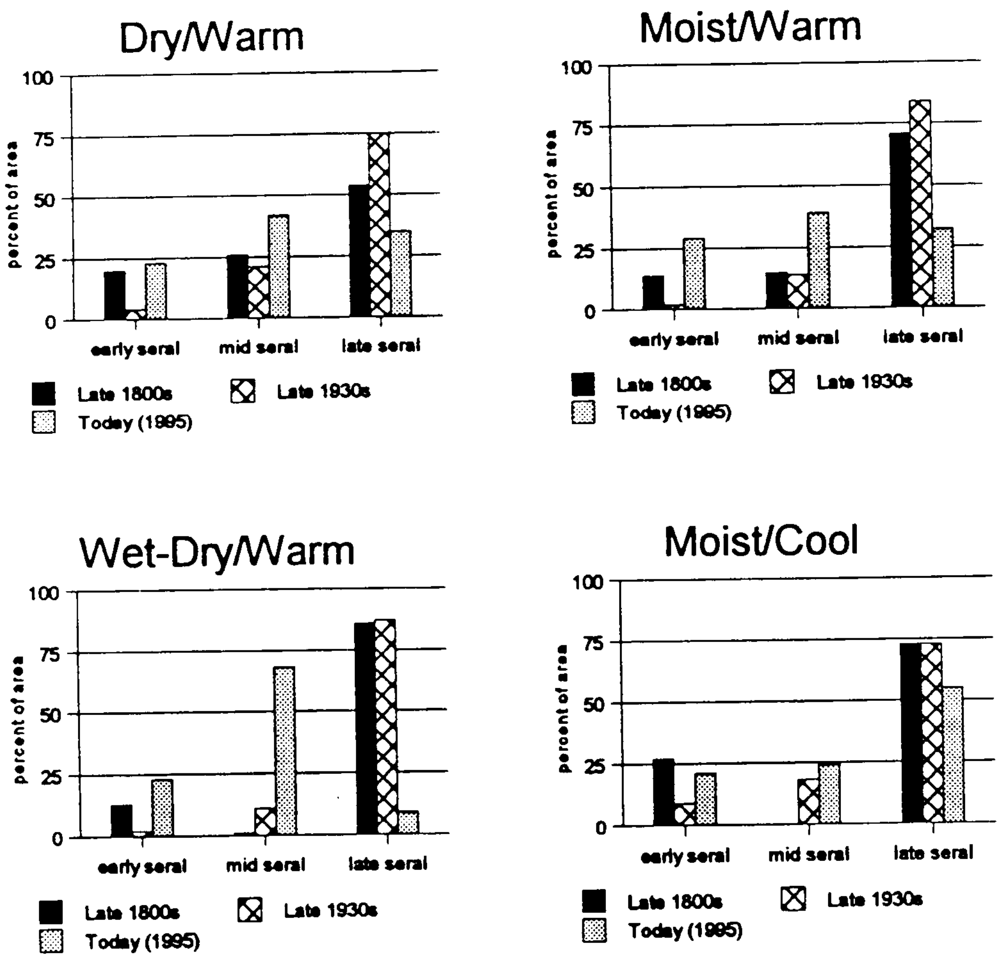


Figure 11. Reference and existing condition of seral stages in the land units of the Little River watershed.

Site Productivity in Young Managed Stands

Since timber management began, the processes of growth, a reflection of productivity, has been altered. In the pre-management era, site productivity was rarely altered; only after a large scale disturbance event, such as a stand replacement fire did productivity change. Activities affecting soil quality such as compaction and hot slash burns, as well as the affect of having overly dense stands and clearcuts in high elevation areas have all worked either collectively or individually to decrease the overall productivity of some of the acres within each land unit. Since none of these variables were measurable in the past, we must look at the current condition to determine which sites may have altered productivity (Table 5).

Table 5. Management activities and factors affecting stand productivity in young managed stands of the Little River watershed by land unit.

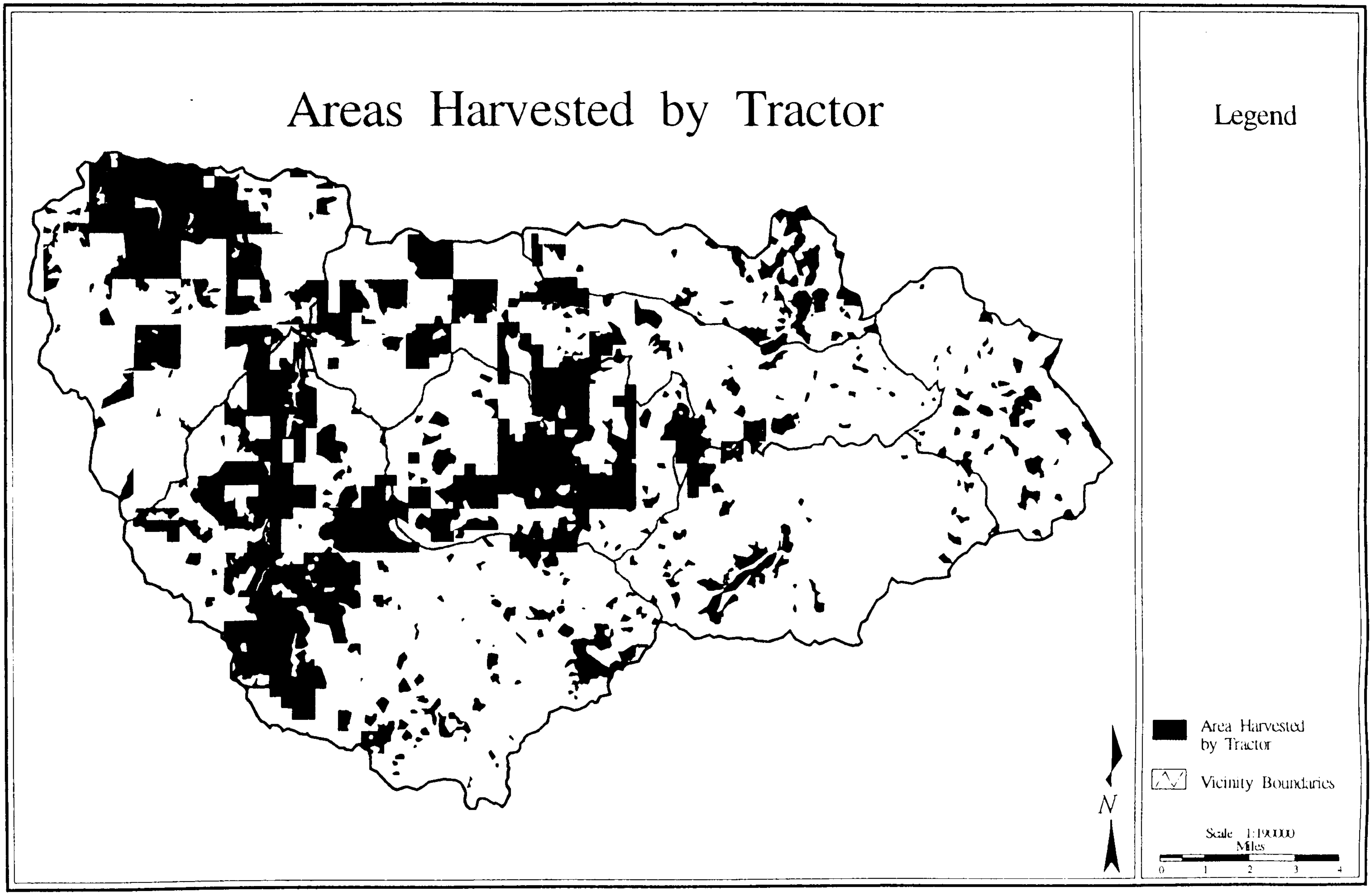
Land Unit	% of land unit acres tractor harvested (all ownerships)	Approx. % of land unit acres burned hot following timber harvest during the 1970s and 1980s (FS only)	Current % of acres by stand density (stands harvested prior to 1970) - (FS only)			Current % of acres that took > 15 yrs for trees to reach breast height (stands harvested prior to 1970, FS only)
			High	Med	Low	
dry/warm	22%	39%	27%	60%	14%	24%
moist/warm	25%	41%	31%	55%	13%	27%
wet-dry/warm	62%	24%	64%	35%	1%	17%
moist/cool	16%	19%	26%	48%	27%	49%

Soil Quality

Compaction:

Approximately 35,300 acres or 27 percent of the land in the watershed (Figure 12) has been harvested or had the site prepared for planting using tractors. Acres that have been tractor harvested within the Little River watershed are displayed by vicinity in Appendix C. The amount of land area within the watershed that has been compacted by tractors varies with the type of soil, soil moisture during logging, and degree of regulation (whether or not skid trails were designated and followed). In the wet-dry/warm land unit where slopes are gentle, early tractor logging that didn't utilize designated skid trails caused extensive compaction. Quite commonly, at least 20 percent of a tractor harvest unit will have soils that are detrimentally compacted; however, other places in the watershed have up to 80 percent of the ground within a tractor harvest unit compacted.

Figure 12



Areas Harvested by Tractor
Legend
Area Harvested by Tractor
Vicinity Boundaries
Scale 1:190000
Miles
0 1 2 3 4
N

As a result of compaction, individual trees can exhibit growth problems. Literature from studies conducted outside of Little River have observed reductions in root growth, height, and timber volume. A 35 percent increase in soil bulk density (loss of soil pore space) can reduce Douglas-fir sites from Site II quality ground to Site III (Froehlich and McNabb 1984). In compacted areas, trees tend to have shallow root masses which increases their susceptibility to blowdown, while black stain root disease can take hold and cause mortality. Douglas-fir trees growing in tractor skid trails took four years longer to reach breast height and produced only one-quarter of the volume than adjacent trees in logged, but relatively uncompacted areas, 32 years after harvest (Wert and Thomas 1981). These findings have been observed during field reconnaissance of harvest unit (those harvested prior to 1970) skid roads on Forest Service managed lands within the Little River watershed. However, how compaction effects overall stand growth is unknown (Tappeiner 1995). Regardless, compaction is a very long term impact: natural recovery time is unknown, but Power (1974) reported no appreciable recovery of compacted soils after 40 years.

In addition to impacts to site productivity, soil compaction can also increase overland water flow. Overland water flow will reach stream channels more quickly than if it were to infiltrate through the soil; increasing peakflows. See Chapter 4, effect of roads on peakflows for further information.

Awareness of the causes and results of soil compaction has increased. Today, skid trails are kept to a minimum and in many areas on public land, tractor logging has been replaced with skyline logging. Compaction occurs less now than it did in the past and will continue on this downward trend for federally managed land.

Fuels reduction:

Fuels reduction treatments, such as slash burning (both broadcast and hand pile) are commonly used methods of reducing fuels following timber harvest. Primarily during the 1970s, hot burns were the norm (Table 5). Burning was conducted with the objective of creating a clean unit to make the area easier to replant. These hot burns consumed much of the organic matter, possibly reducing the areas' productivity. This is especially true for the dry/warm and moist/cool land units, which are less resilient to loss of organic matter and take longer to recover.

The use of hot broadcast burning is expected to be reduced on federally managed land, although the use of low intensity prescribed underburning should be increased in order to mimic natural fire. Concerns about smoke drifting into populated areas, hazards of burning next to private land, policies on leaving dead and down wood for long-term site productivity, and reduced clearcut acres to treat have all worked to lessen the number of acres needing fuels treatment. Broadcast burning is now conducted in the spring with fewer "hot" burns. Less resource damage from broadcast burning can be expected. Hand piling and burning to treat logging slash on federally managed land is expected to continue. Intense burns will continue to occur in piled areas, and while not over a broad area, all the soil organic matter is consumed, impacting the productivity of the site at the location of the burn pile.

Large wood:

The amount, distribution and rate of decay over time of organic matter, including Large Woody Debris (LWD), is a function of a site's temperature and moisture regime as well as the frequency of disturbance that a site experiences. In unmanaged forests of the Oregon Cascades, the distribution of LWD was found to differ significantly by moisture regime with the amount of LWD being greater on moist than on dry sites (Spies, 1988). Furthermore on all sites, the amount of LWD over time has been shown to follow an up-and-down pattern with stand development up to 500 years. The highest levels of LWD are found in old-growth stands and the lowest levels in mature stands (80-120 years). The most prolonged minimum levels occurred in stands where frequent fires burned early in succession (this condition is most likely in dry/warm land units).

The cycle of death and decay in unmanaged forests has been a long term and dynamic process. The structure large wood provides for decomposers, the organic matter it provides the soil, and its role in the storage and release of nutrients and water is essential to the long term productivity of forests. In fact, the difference in productivity (and resilience to disturbance) between land units reflects in large part, the sites ability to sustain this resource over time.

The role of LWD has been recognized in the Northwest Forest Plan: "To maintain long term productivity following a stand replacement disturbance, management should retain adequate LWD quantities in the new stand so that in the future it will still contain amounts similar to naturally regenerated stands" (Record of Decision, pg. C-14). Standards and Guidelines state that 120 lineal feet per acre of logs greater than or equal to 16 inches in diameter and 16' long shall be left in regeneration harvest units (ROD C-40), although standards and guidelines from current plans apply if they provide greater amounts. Such as the case with the Umpqua National Forest Plan Standards and Guidelines for large wood, which calls for leaving 250 lineal feet per acre greater than 20 inches in diameter at the small end in each harvest unit.

Many past timber harvest prescriptions have largely over-looked or removed this important resource. To recruit and retain LWD in managed stands, managers will need to know (Neitro et al. 1985):

1.) The existing forest land base by land unit and age class (these parameters directly affect the size, number and dynamics of LWD);

2.) The current condition and objectives for stands in the land base (by land unit);

3.) Information concerning the rate of decay processes affecting LWD and the quality of snags provided over time.

Stand density:

Stand density represents the number of trees per acre that occupy a given area. Areas that have low densities may not be as productive as they could be for commodity volume production. Stands that are too dense may also be less productive (in terms of wood products) than they could be because too many trees are competing for a limited amount of available growing space, light, nutrients, and water. Historically, disturbance events determined how many trees per acre became established. In dry/warm and moist/warm land units, low intensity fires kept density levels low to moderate in younger and older stands. Moist/cool land units exhibit low to moderate densities due to the cold, wet site conditions, while wet-dry/warm land units would exhibit areas of dense stands, due to high productivity and low frequency of fire.

Currently in young stands, most stand densities are a product of tree planting and natural regeneration (Table 5). Forest management policies of the 1970s and 1980s encouraged planting at high densities to help ensure reforestation success. Forest Service records of harvest acres cut prior to 1970 show that high density stands represent 30 percent of the "older" young growth stands (those stands that were harvested earliest), while 16 percent of these young stands are at a low stand density. The wet-dry/warm land unit can carry higher stand densities due to good to excellent growing conditions - soils are deep and terrain is gentle. On managed lands, pre-commercial thinning and fertilization (see map 1 in Appendix C for areas fertilized) has been commonly prescribed for young stands to reduce stand densities and stimulate tree growth.

Today, many dense young stands are in need of treatment. Since 1980, clearcut harvesting on public lands within the watershed has generated over 11,000 acres of land that is or will soon be in need of density adjustments using precommercial thinning. Some young stands are passing the pre-commercial thinning stage and have not been thinned. These stands will soon come into the commercial thinning stage. Delays in needed pre-commercial thinning operations can slow down growth to a point of stagnation. High stand densities will increase a tree's height to diameter ratio (a measure of how tall a tree is versus how wide). A value greater than 90 means a tree may be too tall for its diameter and blowdown (or stem breakage) is likely to occur (Oliver 1990).

Breast Height Development:

The time it takes for a tree to reach breast height (4 ½ feet) also measures site productivity. Some of today's young stands are taking longer to reach breast height age than what is predicted from growth and yield calculations used in management plans. Possible causes of this lag include harvest related problems such as compacted soils, high water tables, frost pockets, or harvesting on areas too rocky to reforest and other problems such as deer/elk browsing and competition from shrubs. For example, the moist/cool land unit has 48 percent of its acreage in the slow development category, due to both past harvest practices and site limitations (the growing season is limited to less than 100 days). In contrast, other young stands, like some in the dry/warm land unit, are reaching breast height age quickly. These highly productive sites may be the areas best suited for intensive timber production.

Of the approximately 11,000 acres of young growth stands cut before 1970 in Forest Service managed land, almost 1/3 (3,000 acres) of the acreage took longer than predicted to reach breast height. Because the time it takes for the trees to reach crown closure might be delayed, hydrologic recovery may be influenced (see Chapter 4, page Aquatic-40 for further discussion on hydrologic recovery). An analysis of some young managed stands on BLM managed lands within the watershed show that no trees took longer than 12 years to reach breast height after planting.

Site Index:

Site index is defined in terms of the total height of the largest, full crowned trees in a given stand at a given age (Wenger 1984). It is an expression of productivity, usually displayed as a number. A site index assigned to a given area is based upon the areas ability to grow a merchantable tree. In a more general sense, it is also used to imply various other characteristics of the area which include vegetation, landform, soil, and climate (Wenger 1984). For young stands, average dominant and co-dominant trees are measured for both their height and age. These numbers are then averaged again to assign a site index to a stand, using King's 1965 Douglas-fir tables (KD) on a 50-year basis.

In Little River, site classes for young stands were determined by measuring stands harvested between 1940 to 1970 (Figure 13). Activities that affect an area's site class include timber harvest and burning. In general, areas where intensive harvest occurred using ground-based skidding have suffered some loss of productivity.

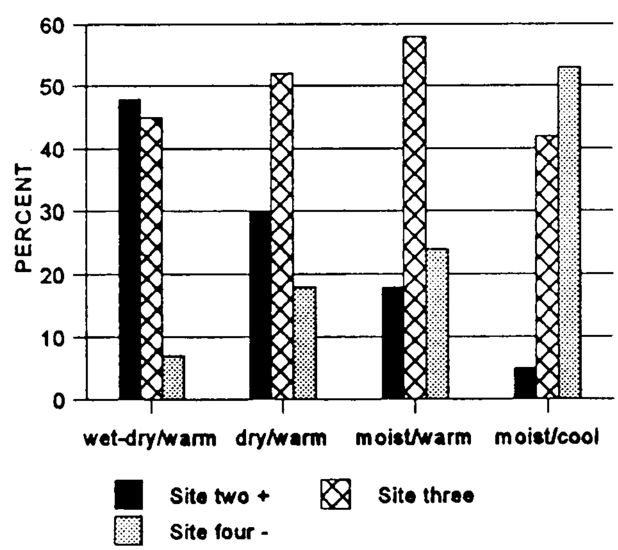


Figure 13. Percentage of young stand acreage in each site class by land unit for Forest Service managed land in the Little River watershed.

On areas classified as site two or three, growth rates are expected to be fairly rapid. However, in many areas of the watershed, diameter growth rates tend to be slow (Table 6). Field observations and stand exam records on the North Umpqua Ranger District have established that diameter growth rates of three inches per decade represents slow growth for stands between 15 and 35 years, breast height age. This is especially true for the wet-dry/warm land unit, which has the most acres classified as site class two, but also has a significant number of acres in the slowest growth rate category. The wet-dry/warm land unit should have some of the fastest young stand growth rates. This land unit represents the most potential to regain productivity using restorative measures.

Table 6. Acres of young managed stands in each diameter growth rate category (slow, moderate, and fast) on Forest Service managed land in the Little River watershed.

Land Unit	Slow growth rate (1 to 3 in/decade)	Moderate growth rate (3.1 to 3.4 in/ decade)	Fast growth rate (3.4 to 5.8 in/decade)
dry/warm	250 ac	579 ac	708 ac
moist/warm	320	451	1119
wet-dry/warm	264	35	62
moist/cool	274	277	802
Totals	1109	1342	2690

Site Productivity in Mature Stands

Site productivity in mature stands (those in the mature or old-growth seral stages) is influenced by competition and thinning treatments applied, which allocates or re-allocates moisture, nutrients, and sunlight. Historically, only natural disturbances such as severe fire events, volcanoes, earthquakes, and landslides significantly altered productivity in mature forests.

Competition:

Competition for nutrients, light, and water from trees, shrubs, or grasses (Tappeiner 1995) can slow stand growth. One source of competition comes from the coniferous understory that grows up underneath the canopy, often called ingrowth. If left unchecked, ingrowth can slow the growth of a stand as growing space becomes restricted and nutrients and water become limited. Individual tree species react differently to competition from ingrowth. Species such as sugar pine and ponderosa pine do not grow well when the understory becomes thick and dense. They begin to experience stress, which can make them susceptible to infestations by mountain pine beetles, eventually causing mortality. Historically, ingrowth was controlled by fire. Land units, such as dry/warm, experienced more frequent fire, had open understories, and fire tolerant species in the overstory. In contrast, moist/cool land units had more shade tolerant species underneath the canopy such as western hemlock and white fir, which would grow thick until the next fire episode occurred.

Competition from ingrowth and high stand densities have affected many of the mature stands that exist in the watershed today. With the advent of modern fire suppression activities, much of the watershed has not experienced disturbance as often as it did historically. Where fire was once frequent in the past (such as in the dry/warm land unit), stands would experience frequent underburning and stand replacement fires, limiting the stands ability to carry high volumes over long periods of time. Fire suppression has led to the creation of stands that are very dense and thick. These stands carry more trees per acre now than they did in the past. On Forest Service managed land within the watershed, some acres are carrying higher densities than what was likely to have occurred in the past (Table 7). Some late seral and mid seral stands appear to have changed from having mostly large trees to a structure that has a higher component of smaller trees. For example, in the dry/warm land unit, over 7000 acres are carrying high densities of smaller diameter trees. These stands are at risk of experiencing a high intensity fire in the future. High intensity fires are capable of causing extensive damage to the soil resource because they consume nearly all of the organic matter and much of the large wood, thus loss of long term site productivity is likely with these intense fires. In addition, the risk of soil erosion and sedimentation in streams increases as organic matter and vegetation on the site decreases.

Table 7. Acres in each land unit by seral stage that have high densities for Forest Service managed land in the Little River watershed.

Land Unit	Late Seral	Mid Seral
dry/warm	7700 ac	9142 ac
moist/warm	8829 ac	3348 ac
wet-dry/warm	885 ac	261 ac
moist/cool	6980 ac	1516 ac

Stand densities are expected to continue to increase in the short term. As density management activities are undertaken, stand densities should slowly return to a more natural level.

Thinning treatments:

In mature stands, thinning treatments increase the growing space for the remaining trees. As a result of more growing space, leave trees grow faster, producing more volume on a site, while also increasing stand resiliency to disturbance. Yield projections for mature stands based on various thinning prescriptions for each of the land units within the Little River watershed were developed for stands on Forest Service managed land. These can be found in Appendix C. Most mature stands thinned during the 1970s and 1980s had approximately 1/3 of the basal area removed from the stand (mostly intermediate and suppressed trees). To date, 2870 acres on Forest Service managed land has been commercially thinned in the watershed. Little or no monitoring has been done on stands which have been thinned, so it is difficult to determine what the response of these stands has been and whether or not trees are growing to their full growth potential.

Thinning treatments can be used to lessen a stand's susceptibility to high intensity fires and to restore stand vigor over time. Understory diversity can be increaed by increasing light levels that reach the forest floor. Slash from thinning increases the fuels available to burn, increasing the fire hazard. Thinning can also introduce conifers into the understory and begin the development of a two-storied stand (Tappeiner 1995). In addition, thinning usually produces bigger trees, which can be used as future snags or for commodity production. Commercial thinning opportunities will increase as stands harvested during the 1940s through the 1960s become commercially marketable.

Plant Species Diversity

Individual plant species have unique abilities to grow and survive in a particular climate. Groups of species that occur together are referred to as plant associations, which represent an integration of site factors such as climate, landform and soil moisture. Plant associations can be used to describe many stand characteristics such as system composition, canopy layers, live and dead tree diversity and down wood. Appendix J displays plant associations (project level classification) and plant series (an aggregation of associations) by aspect for land units in the Little River watershed.

In general, species diversity has changed throughout the watershed. In some early seral forests, there are more species than historically present, sometimes due to an influx of non-native species. In other early seral areas, species diversity has declined due to an aggressive program to control competing vegetation, a lack of seed source when the stand was cut, and planting mostly Douglas-fir following harvest. In mid and late seral forests, species diversity has probably held steady or perhaps slightly declined (due to salvage logging and firewood programs that removed hardwoods) over natural conditions.

The choice of stand regeneration method can also have an effect on stand diversity. During the 1940s and 1950s, harvest units were usually left to naturally regenerate themselves. Tree planting began in the 1960s, and genetic programs began in the 1970s. Douglas-fir became the regeneration species of choice, leading to the creation of extensive acres of Douglas-fir forests. Natural regeneration is being used more today on Forest Service managed land. In addition, other minor species are being planted in harvest units on BLM managed land. Understanding light levels necessary to grow shade intolerant species such as Douglas-fir and pine in young managed stands (see Appendix C for light level discussion) will help land managers utilize natural regeneration more often.

The Relationship of Land Units to Species Diversity

Each land unit in the Little River watershed has a unique ability to support different plant associations. An area's potential vegetation - that vegetation which would occur on a site in the absence of management activities - is what grow's best given the climate, soils, and geology of a particular site.

Dry/Warm Potential Vegetation: Historically in Little River, the vegetation type and growth rate was primarily controlled by moisture stress. On steep south-facing slopes, Douglas-fir forests dominated, an adaptation to the frequent, intense fire behavior episodes that were likely on steep slopes in this land unit. These Douglas-fir forests formed a mosaic with the drier hemlock plant associations, which were probably being perpetuated where fire intensity was less severe or less frequent. On gently sloping deep-soil landforms, a mixed conifer forest would often be present (white fir/dwarf Oregon-grape/salal) and was probably an adaptation to a relatively frequent, low-intensity fire regime. The following relationship between plant associations and landforms in the dry/warm Western Cascades land unit (Table 8) was developed from Forest Service Land Resource Inventory (LRI) data collected in the field (in order of prevalence):

Table 8. Plant associations and landforms for the dry/warm land unit of the Western Cascades province.

Common Plant Associations	Landform Relationship
Douglas-fir/dwarf Oregon-grape/sword fern	South aspects, steep slopes Moist for Douglas-fir sites High frequency of low intensity fires * On upper slopes or ridge tops *
western hemlock/incense-cedar/salal	All aspects, steep slopes Salal and Pacific rhododendron always present i.e., indicative of acidic rock Multi-storied stands *
Douglas-fir/salal/sword fern	South aspects, steep slopes Drier than Douglas-fir/dwarf Oregon-grape/ sword fern One - two storied stands * Moderate frequency fires *
white fir/dwarf Oregon-grape/salal	Mostly south aspects Deep soils on gentle to moderately steep slopes

Common Plant Associations	Landform Relationship
western hemlock/salal/western twinflower	All aspects Deep soils Straddles moist/warm, moist/cool land units

* Plant Association Guide

Moist/Warm Potential Vegetation: Moist western hemlock plant associations dominated this land unit and indicate a microclimate where moisture stress was minimal. Adequate soil moisture for plant growth was associated with northerly aspects, high soil moisture storage and lower slope positions. The following relationships between moist/warm plant associations and landforms (Table 9) were developed from field collected data:

Table 9. Plant associations and landforms for the moist/warm land unit of the Western Cascades province.

Common Plant Associations	Landform Relationship
western hemlock/salal/western twinflower	On south slopes with deep soils and gentle to moderately steep slopes; Also on north slopes with moderate to deep soils, all slope steepness
western hemlock/vine maple/snow bramble	Mostly south aspects, on upper elevations with deep soils
western hemlock-bigleaf maple/sword fern	On north aspects with deep soils and steep slopes
western redcedar/Pacific rhododendron/ western twinflower	North aspects, mid to lower 1/3 of slope and in valley bottoms
western hemlock/western redcedar/Oregon oxalis	Valley bottom, foot slope, lower 1/3 of slope

Frequent, low to moderate intensity fire has shaped the moist/warm stand structure historically. Two-storied and single-storied stands were common. The potential for multi-storied stand structure was accentuated by two land unit attributes: 1) land unit location which would include low-slope positions and streamside landforms that are often refuges from fire, and 2) the diversity of shade intolerant species that add structural layers to stands in the absence of fire. In most locations, fire has prolonged the mature seral stage and selected against fire-intolerant species. The difference between the existing and reference seral-stage distribution portrayed in the At-a-Glance is a reflection of both the abundance of late-seral forest and the easy access afforded by moist/warm timber resources on moderate to gentle slopes.

Wet-dry/warm Potential Vegetation: The wet-dry/warm land unit supported a very productive forest, limited by only moisture stress in the driest, convex microsites and excess moisture in the wettest areas. For the most part, the early seral stage development was rapid like the surrounding moist/warm land unit. Openings filled in rapidly and were prolonged only in the wettest areas as an extended shrub stage.

This land unit once was the stronghold of western redcedar in Little River, a product of the land unit's surplus of soil moisture. Today, however, almost no western redcedar can be found in this land unit, due to extensive reforestation of Douglas-fir following timber harvest. The following relationships between wet-dry/warm plant series and landforms (Table 10) were developed from field collected data:

Table 10. Plant series and landforms for the wet-dry/warm land unit of the Western Cascades province.

Plant Series	Landform Relationship
Moist hemlock/western redcedar	Earthflow landslide deposits, gentle old surfaces on upland plateau. Western redcedar forests in concavities

Moist/cool Potential Vegetation: Both the type of vegetation and its growth would be limited by cool temperatures. This is the realm of the Pacific silver fir and western white pine in a matrix of cool western hemlock forests. The following relationships between plant associations and aspect (Table 11) were developed from field collected data:

Table 11. Plant associations and landforms for the moist/cool land unit of the Western Cascades province.

Plant Associations	Landform Relationship
western hemlock/vine maple/Oregon oxalis	North aspect only
white fir	All aspects
western hemlock/thin-leaf huckleberry/ western twinflower	South aspects, deep soils
Pacific silver fir/vine maple/coolwort foamflower	Mostly north aspects
western hemlock/Pacific silver fir/thin-leaf huckleberry	All aspects

Rare Plants, Non-Native Plants, and Native Revegetation

Information on currently listed threatened, endangered, and sensitive plants (TES) is lacking for nearly all of the land within the Little River watershed. Certain plant groups, such as grasses, sedges, rushes, aquatic species, bryophytes, and lichens remain almost uninvestigated. With the exception of BLM Research Natural Areas, non-timber habitats remain almost unexplored.

The staff of the Douglas County Museum Herbarium with the assistance of the Roseburg chapter of the Native Plant Society of Oregon has been conducting plant surveys in the Little River Watershed for many years and have kept a composite list of vascular plant species (which may not include some of the above mentioned plant groups) for the area (on file at the North Umpqua Ranger District).

Threatened, Endangered, and Sensitive (TES) Plant Surveys

Prior to 1990, records were not kept on which Forest Service lands had been surveyed for rare plants. From 1990 to the present, 678 acres (1.1 percent of the watershed) have been surveyed, but only 243 acres (0.4 percent of the watershed) of that total have had surveys that meet current standards. Surveys for fungi, lichen, bryophytes, rushes, sedges, and aquatic plants have not been conducted and for all practical purposes, the Forest Service lands in the watershed remain unexplored for TES plants. The Roseburg BLM has surveyed for Threatened, Endangered, and Sensitive plants since 1977, and has surveyed 4,139 acres to date. Surveys for lichens and bryophytes began in 1995, with 134 acres surveyed to date.

Thirty-one sites representing eight currently listed TES species are known to occur in the watershed (Table 12). No attempts have been made to prioritize potential habitat within the watershed. Some of the currently listed TES species have easily definable habitat while others do not. Some are generalists that can be expected to occur throughout coniferous forests. Since species status changes periodically, prioritization of potential habitat is best undertaken at the project level. Specific habitat descriptions for TES plants suspected or known to occur on Forest Service lands are included in Appendix G.

Table 12. TES plant species known to occur in the Little River watershed by status.

Common Name	Scientific Name	FWS Status	BLM Status	FS Status
Wayside aster	*Aster vialis (ASVI)*	C2	Candidate	Sensitive
Woodland milkvetch	*Astragulus umbraticus (ASUM)*	---	Assessment	Sensitive
Umpqua mariposa lily	*Calochortus umpquaensis (CAUM)*	C1	Candidate	Sensitive
Siskiyou fritillary	*Firtillaria glanca (FRGL)*	---	---	Sensitive
California globemallow	*Illiamna latibratiata (ILLA)*	---	Assessment	Sensitive

Common Name	Scientific Name	FWS Status	BLM Status	FS Status
Columbia Lewisia	*Lewisia columbia v. columbiana (LECO)*	---	---	Sensitive
California sword fern	*Polystichum californicum (POCA)*	---	Assessment	Sensitive
Thompson's mistmaiden	*Romanzoffia "thompsonii" (ROTH)*	---	Sensitive	Sensitive
Dwarf-flowered horkelia	*Horkelia congesta spp. congesta (HOCO)*	C2	Candidate	---
Sandwort	*Minuartia cismontana (MICI)*	---	Tracking	---
Punctate water-meal	*Wolffia borealis (WOBO)*	---	Assessment	---

Distribution by vicinity

Vicinity	Total Sites	Sites per species										
		ASVI	*ASUM*	*CAUM*	*FRGL*	*ILLA*	*LECO*	*POCA*	*ROTH*	*HOCO*	*MICI*	*WOBO*
Lower Little River	6			6						2	1	
Cavitt Creek	2		1						1			1
Middle Little River	3	1	1					1				
Wolf Plateau	3					2			1			
Emile Creek	4							2	2			
Black/Clover	10		1			3	4	1	1			
Upper Little River	3		1		1				1			
Watershed Total	34	1	4	6	1	5	4	4	6	2	1	1

ROD Species

Some species designated by the Northwest Forest Plan (ROD) as requiring special management (Table C-3 and protect and buffer) have not yet had survey protocols established. However, some efforts have been undertaken. Five one acres plots representing different habitat types were intensely inspected for lichen occurrence. BLM personnel have included easily recognizable species in their regular surveys for TES plants.

Fifteen species of lichen listed in Table C3 of the Northwest Forest Plan were located in the spot sampling undertaken in 1995. One "Strategy 1" (see Appendix G) species, the rare Hall's lungwort (*Lobaria hallii*) was found. The remaining fourteen species are designated "Strategy 4" and are common in at least parts of the watershed. . A search of Forest Service ecology plot records revealed three sites for Candystick (*Allotropa virgata*). No occurrences of Mountain lady's slipper (*Cypripedium montanum*) are known from the area. No fungus listed in the ROD has been found.

On BLM administered lands, Bug-on-a-stick (*Buxbaumia piperi*), a protect and buffer species, has been found with some consistency. Site location information is not yet available. Habitats of protect and buffer species are designated as Managed Late-Successional Areas, and are managed as such.

Potential species

The list of species closely associated with late successional and old-growth forests that could occur in the Little River Watershed is included in Appendix G. Some of the listed species are likely to be common within the area while others will be quite rare.

Non-native Plant Species

Non-native plant species are those species that did not originally occur in the United States. Means of transport include wind, water, animals, and human activity. In cases where movement occurs over long distances, human activity (vehicle traffic) generally provides the main means of transport.

The introduction of non-native plants has been going on at a rapid rate on the North American continent since European peoples began their westward migration some 300 years ago. The current, rapid pace of human development has increased the rate of introduction of new species. Occasionally a new species is met with few or no factors limiting its spread. These plants are not preyed upon to a great degree; their habitat needs are easily filled and their ability to reproduce is not restricted. Consequently they spread rapidly, easily displacing native plants and organisms that depend on them. This poses serious ecological and possibly economical impacts. The exact extent of the presence of such species in the Little River watershed is not known. A complete list of all species recorded in the Little River watershed and nearby is included in Appendix G.

Noxious Species

Noxious weeds are those plants that have been officially designated as such by federal or state law. The Oregon State Department of Agriculture defines these as plants that are "injurious to public health, agriculture, recreation, wildlife, or any public or private property". Because this designation focuses on human economy and agriculture there are two cases in which native plants are included. These species, giant horsetail and western horsetail, will be managed as native species and will not be subject to noxious weed management efforts.

The Oregon Department of Agriculture (ODA) determines which species will legally be considered 'noxious' in the state of Oregon, each of which carries with it an eradication "plan", which may be on the local, county, or state level. See Appendix G (Oregon State Noxious Weed List) for more detail on these species.

Of the 48 species of noxious weeds that either occur, or have a significant potential to occur, within the state, ten of these species (disregarding the two native species) can be found in the Little River watershed (Table 13). Five are considered to be so widespread (tansy ragwort, St. Johnswort, Canada thistle, bull thistle, and Scotch broom) that most disturbed ground is occupied by at least one of these species. Eleven more are known to occur in close proximity and have the potential to colonize the area in the foreseeable future. Of particular concern are gorse, yellow star-thistle, milkthistle and French broom.

Table 13. Noxious weeds known to occur or in close proximity to the Little River watershed

Noxious Weeds Known To Occur In Little River	Noxious Weeds In Close Proximity To Little River
diffuse knapweed *(Centaurea diffusa)*	French broom (*Cytisus monspessulanus*)
meadow knapweed *(Centaurea jacea x nigra)*	gorse (*Ulex europeaus*)
Canadian thistle (*Cirsium arvense*)	Italian thistle (*Carduus pycnocephalus*)
bull thistle (*Cirsium vulgare*)	Japanese knotweed *(Polygonum cuspidatum)*
poison hemlock (*Conium maculatum*)	Medusahead (*Taeniatherum caput-medusa*)
field morning glory (*Convolvulus arvensis*)	milk thistle (*Silybum marianum*)
Scotch broom (*Cytisus scoparius*)	star thistle *(Centurea spp.)*
purple loosestrife (*Lythrum salicaria*)	puncturevine (*Tribulus terrestris*)
tipton weed (*Hypericum perforatum*)	Russian knapweed (*Acroptilon repens*)
tansy ragwort (*Senecio jacobaea*)	wooly distaff thistle (*Carthamus lanatus*)
	Spanish broom *(Spartium junceum)*
	Yellow toadflax (*Linaria vulgaris*)

Of the noxious species listed above only diffuse knapweed and purple loosestrife have been identified as a priority species by both the Forest Service and BLM. Diffuse knapweed occurs within the watershed on two sites, occupying about three acres above Cavitt Creek. A clump of purple loosestrife was found growing along Little River Road in August, 1995. Meadow knapweed, widely used in the early 1960's by the Forest Service for roadside erosion control, is also a slow moving, but aggressive colonizer that has become so widespread that eradication of the population is unlikely. The BLM is actively attempting to limit the spread of Scotch broom through roadside mowing. The thistles, tipton weed and tansy ragwort are considered by agency personnel to be too widely distributed to be eradicated.

Many of these noxious weeds are spreading rapidly. Roseburg BLM District estimates that the rate of increase on lands the agency administers within the county could be as high as 1000 acres per year. Typical rates of spread for species with high potential to occur in the watershed range from 8 percent to as high as 24 percent per year with an average of 14 percent (USDI BLM 1994b) - a doubling of infested acreage every five to six years or less. Even with repeated treatment of known sites, occurrences are expected to increase due to the movement of seed into the area from outside sources and by perpetuation of seed production on private land.

Forest Service and BLM roads within the Little River watershed (600 road miles) were surveyed for the presence of twelve of the above noxious species considered to be a priority for locating, monitoring, and control or eradication. The following species were surveyed for:

Common name	Scientific name
wooly distaff thistle	*Carthamus lanatus*
diffuse knapweed	*Centaurea diffusa*
spotted knapweed	*Centaurea maculosa*
yellow starthistle	*Centaurea solstitialis*
rush skeletonweed	*Chondrilla juncea*
poison hemlock	*Conium maculatum*
leafy spurge	*Euphorbia esula*
dyers woad	*Isatis tinctoria*
dalmation toadflax	*Linaria dalmatica*
yellow toadflax	*Linaria vulgaris*
purple loosestrife	*Lythrum salicaria*
gorse	*Ulex europaeus*

The survey was completed in July, 1995. Areas along the roadsides were examined, with special emphasis given to areas in early seral stage, rock quarries, recreation sites, and other areas of recent disturbance. No populations of any of the twelve species were detected. Because most of the Forest Service and BLM roads are in the upland areas of the watershed, the survey did not include low elevation areas of lower Little River, middle Little River, and lower Cavitt Creek, where more agricultural use, disturbance levels, and vehicle traffic create higher probability for invasion of noxious weeds.

Aggressive Non-natives

Besides those plants listed as noxious there are many aggressive species that are compromising the ecology of the area and may threaten native communities (Table 14). For the most part, these are pioneer species that occupy disturbed areas in great numbers. In some cases the invasive ability of these plants rivals those listed as noxious, but they are either already so firmly established that eradication efforts have not been useful or their ecological threat has not been recognized.

Table 14. Aggressive species of concern

COMMON NAME	SCIENTIFIC NAME
Bird'sfoot trefoil	*Lotus corniculata*
Cat's ear	*Hypocharis radicata*
Cheat grass	*Bromus tectorum*
Common mullien	*Verbascum thapsis*
Dogtail hedgehog grass	*Cynosurus echinatus*
Evergreen blackberry	*Rubus laciniatus*
Himalayan blackberry	*Rubus discolor*
Orchard grass	*Dactylis glomerata*
Ox-eye daisy	*Chysanthemum leucanthemum*
Queen Anne's lace	*Daucus carota*
Red sorrel	*Rumex acetosella*
Ripgut	*Bromus rigidus*
Soft brome	*Bromus mollis*
Sweet pea	*Lathyrus latifolia*
Teasle	*Dipsacis sylvestris*
Timothy	*Phleum pratense*

Three of the species listed are of particular concern. On the North Umpqua Ranger District, cat's ear and ox-eye daisy dominate recent clearcuts. Both of these spread by windborne seeds and are commonly transported in surface gravel for roads. Ox-eye daisy also increases itself by rooting from the stems. Neither of these species is easily eradicated. Dogtail hedgehog grass is quite likely the most common grass species in the Little River watershed. Although no studies have been conducted, the species has shown up in all Forest Service surveys, dominating most openings once inhabited by native grass species.

Habitats and processes altered

Many non-native species are capable of invading and dominating disturbed areas. Taken as a group, field observations indicate they can occupy as much as ninety percent of the available habitat in disturbed (clearcuts, road cuts) areas. Considering that 60 percent of the land in the Little River watershed has been harvested and roaded, and many more acres were intensively grazed in the past, very little of the Little River watershed has not been invaded by one or more aggressive non-native species.

Most of the aggressive non-natives are pioneer or early seral species. Both fire and timber harvest activities reduce plant communities to early stages of development, providing opportunity for expansion of non-native populations. What effect this has on the native species whose niche they occupy is unknown. Arguments are often made that non-native pioneer species will die out over time as the vegetation moves from open clearcuts to forested conditions. To some extent this is true. Pioneer plant populations decline in shaded conditions provided by tightly growing trees. However recent field work indicates that they do persist where their needs are met and will not simply disappear as succession runs its course. We can expect that they will populate future disturbed sites even if no further seed is introduced. This means the native species will be out-competed for occupancy of future disturbed areas as well.

How this disruption of early seral processes effects the long term viability of native pioneer plants and the creatures that depend on them is unknown. The extent of the detrimental effect on the composition of later seral herbaceous communities is, for the most part, also unknown. However, there are some examples of species which alter succession.

Gorse and scotch broom are two species that have demonstrated an ability to change patterns of succession. Both of these species dominate disturbed sites and form dense thickets which exclude other species from becoming established. Both contain highly flammable oils, are very fire prone, and burn intensely. The plants produce copious amounts of seed that can lay dormant in the soil for decades, then sprout quickly after fire, producing yet another brush field and precluding the establishment of timber producing species.

What we do know is that besides occupying disturbed sites, non-natives are also affecting community structure in unique habitats, although exact species are unknown. In some areas (such as dry meadows) these species have filled a great deal of habitat once occupied by natives. Studies on the Willamette National Forest indicate that unique habitats harbor up to 85 percent (Chambers 1988) of the plant diversity on that forest. Field work done in the Jackson Creek watershed on the Tiller Ranger District in 1994 indicates this percentage may be equally high for the Umpqua National Forest. Impact to individual species and to community structure as a whole is a matter of concern. In addition, field work in Jackson Creek demonstrated that bunchgrass meadows have been particularly damaged. This was attributed to intensive disturbance and introduction of non-native plants resulting from grazing. No fieldwork or botanical assessment has been done for unique habitat in the Little River watershed. Since grazing history indicates that use in Little River has been intense, it is assumed that impacts have been similar and bunchgrass communities, in particular, may be at risk.

Impact to the process of pollination

Besides the plant species immediately replaced by non-native invasion, the most highly affected species may be insects involved in pollination. Native species have established varied and particular relationships with native pollinators. The decrease in plant diversity caused by non-native encroachment can cause displacement or loss of pollinators. Orchids may be particularly at risk, since they often are dependent on a single pollinator. Disturbance of such relationships could lead to extinction of both species (Boyd 1994).

Impacts to wildlife

In addition to affecting pollinators, the replacement of native species by non-natives affects both the structure and food production provided to wildlife by native species. These changes are not necessarily all bad. Himalayan blackberry, provides extensive habitat and food for certain species. The net loss or gain to wildlife in the Little River watershed has not been ascertained, but has potential to be negative.

Another species that has the potential to impact wildlife is purple loosestrife, which rapidly colonizes wet areas through both seed dispersal and rooting stems. If forms dense thickets, crowding out most native plants and animals. Purple loosestrife does not provide food, nesting structure, or useful cover for wildlife, displaces many species, and disrupts the ecological functions of the area it invades.

Impacts to rare plants

Non-native plants impact rare plant species in three ways: 1) by causing physical displacement, 2) loss of nutrient availability and changes in other environmental parameters such as water, light, and temperature, and 3) interruption of crucial relationships with other natives. The extent of this type of disturbance to populations of rare plants is not known. In Little River, the clustered lady's slipper (pollinator unknown) may be at risk due to interruption of pollinator relationships. Extensive unoccupied habitat exists for the plant and it is possible that a connection between non-native invasion, pollinators and the limited occurrence of the plant exists.

The chatter-box orchid (*Epipactis gigantea*) occurs in the splash zone along larger fast moving stream such as Little River. Although the species is not given special status and its pollinator is unknown, it is at the northern edge of its range and has a limited distribution in the watershed. Field observations along the North Umpqua River indicate that the habitat for the plant is being encroached upon by birdsfoot trefoil and meadow knapweed, both aggressive non-natives that were introduced by the Forest Service in the early 1960s to control soil erosion. Both habitat and pollinator may be at risk. Although no field work has been conducted in Little River, the situation is likely to be the same.

Neither the exact nature of the damage to rare plants resulting from the presence of non-native plant species in Little River Watershed nor its extent is known. Based on observed situations, it is reasonable to assume the trend has been negative.

Restorative Actions

Legal mandates are provided to deal with noxious weeds (Appendix G). Policy on public lands toward these species is consistent with State regulations. The Roseburg BLM District has in place an Integrated Weed Control Plan that addresses issues and control efforts. The Umpqua National Forest has made note of the need for a similar document. Until it can be completed the Forest has issued a list of noxious species of concern and provided direction to help prevent the introduction and establishment of new infestations.

At the Regional level, the Forest Service and BLM have a Memorandum of Understanding with the Oregon Department of Agriculture (ODA) to work jointly to prevent the spread of noxious weeds. For further descriptions of pertinent documents and public law see Appendix G.

By far the simplest and least expensive means of control is prevention. One aspect of this is education of the public and agency personnel on how to identify and avoid spreading weeds. The other aspect is simply not engaging in soil disturbing activities. In addition, the interior of large, intact forest stands are the most likely areas to have resisted non-native invasion and may harbor functioning systems not yet identified and long since lost elsewhere. Retention of these communities is important.

Integrated weed management includes planning, inventory, control (including mechanical, manual, chemical, and biological), prevention, education, coordination, and monitoring/research. See Appendix G for more details.

Revegetation efforts

Past and current revegetation efforts have been aimed at controlling erosion on sites where soil has been disturbed by heavy equipment use and/or that have been burned over by fire. Need for this kind of effort continues. However, aggressive species that are not native to the area were used in past revegetation efforts. While the immediate benefit of stabilizing the soil is obvious, no long term monitoring has been conducted to determine the effects of the spreading of these species or the potential for alteration of the natural successional processes. Large scale grass plantings following wildfire may reduce coverage of native forbs and grasses, may out compete trees planted during reforestation efforts, and may produce future fire hazards by creating large areas of fine, flashy fuels (grass).

Planting of herbaceous vegetation has also been undertaken for big game forage production. As long as large populations of elk are desired in the forested areas of Little River, this will continue to be a need. There are native species capable of filling this need. Using native species as a means of preventing weed encroachment is also a concern. Past Forest Service revegetation efforts included aggressive species because of their ability to aggressively colonize and dominate a site (Table 15). As a matter of Forest Service management policy, all sites disturbed by management activity that could cause sediment to reach the streams are planted with erosion control seed mixes. Planting is also undertaken to prevent colonization of sites by highly aggressive and less desirable non-native species.

Table 15. Non-native species used in past forage and erosion control plantings on lands administered by the Forest Service.

Common Name	Scientific Name
alta fescue	*Festuca arrundinaceae*
annual rye	*Lolium multiflorum*
birdsfoot trefoil	*Lotus corniculatus*
colonial bentgrass	*Agrostis tenuis*
meadow knapweed	*Centaurea pratensis*
New Zealand white clover	*Trifolium repens*
orchard grass	*Dactylus glomerata*
perennial rye	*Lolium perene*
sub clover	*Trifolium subterraneum*
timothy	*Phleum pratensis*

Potential species to use for revegetation

Revegetation efforts on Forest Service managed lands have been successful using non-native species and have focused on erosion control (including after fires) and big game forage. Hot, dry sites are particularly difficult to revegetate. Native species that are most appropriate to use on these harsh sites are listed in Appendix G. Experimental nursery propagation of a limited number of these species have taken place with successful results. On-site trials have not yet taken place and the most practical species to use has not been determined.

In general, legumes and grasses are commonly used for revegetation efforts. Legumes are important nitrogen fixers and the added nitrogen to a site can help other plants become established (Appendix G). The Tiller Ranger District is currently experimenting with some of these species in road decommissioning projects and their findings will be applicable to the Little River watershed.

Grasses, while commonly used, may not respond on a site as well as other non-grass native species. However, some native grasses are appropriate for erosion control efforts and may also be useful in providing elk forage. Species that have the potential to be useful for revegetation efforts and that commonly occur throughout the area include blue wild rye, California fescue, California oatgrass, California oatgrass, Columbia brome (*Bromus vulgaris*), and Letterman's needlegrass.

Determination of which species are native to wetlands in the Little River watershed has not yet been made. However, species that would be appropriate for revegetation include cattail, small-fruit bullrush, inflated sedge, slough sedge, coltsfoot, and several other species including slough sedge, common rush, and dagger-leaf rush.

On sites where adequate soil moisture is available, salal, thimbleberry, beargrass, and trailing blackberry all may be worthy of particular attention for development.

Specific areas to revegetate on Forest Service and BLM lands are listed in Appendix G. Opportunities exist to create seed beds on areas where roads will be decommissioned.

Changes In Wildlife Habitat

Wildlife habitat is constantly in a state of change. In any one area, habitat conditions change over time as disturbances and natural succession take place. Habitat for one species increases as it decreases for another species. Thus the cyclic nature of increasing and decreasing populations in a given area through time.

For this analysis, changes in habitat conditions for wildlife were quantified at a broad scale, based on landscape patterns of three seral conditions (early, mid and late). Current habitat conditions were compared to a historical range of conditions to show today's patterns in relationship to the natural cycle. This "reference range" consists of landscape pattern conditions at two separate times, covering a period of about 60-70 years from the late 1800s to the late 1930s. The 1930s mapping represents a point in time where late seral was probably close to the peak in its cycle. The late 1800s mapping was an attempt to depict landscape patterns which would result from a climatic event leading to severe fire conditions that undoubtably occurred at times over the centuries.

The late 1930s mapping was developed through photo interpretation of aerial photographs taken in 1946 of the Little River watershed. From these photos we were able to accurately map landscape patterns for 1946. However, the desire was to create a range of "natural" landscape patterns for this watershed, therefore, clearcuts and other managed areas from the 1946 mapping were converted to match their adjacent seral conditions (usually late seral) and a map of seral conditions for the late 1930s (which predated the advent of intensive timber management in this watershed) was created. The late seral of this map represents mature conifer and old-growth, the mid seral represents smaller/younger conifer regenerating in areas that experienced stand replacement fires in the late 1800s and the early seral represents stand replacement fires of the late 1930s and natural openings such as meadows and rock outcrops.

The mapping of conditions for the late 1800s was done by reverting the mid seral mapped from the 1946 photos into early seral. To depict mid seral, we assumed that areas with steep slopes in the dry/warm, moist/warm and wet-dry/warm land units probably experienced a higher frequency of stand replacement fires and mapped them as such. The natural openings from the late 1930s were retained in the late 1800s mapping. Figures 14-16 depict the seral conditions over time.

With these two mappings of the landscape we developed a "reference range" for landscape patterns to show how they changed through time prior to intensive timber management. The late 1930s mapping is highly accurate, the late 1800s mapping is less accurate as it may over-estimate the amount of early and mid seral, but represents conditions which would probably occur during a severe fire season. Each of the following measures and indices of wildlife habitat is discussed in terms of the reference and current condition.

Landscape Patterns and Seral Conditions

A landscape is the sum of everything that has happened to an area over time. It is not static, but ever changing as its surrounding environment changes. Environmental changes can occur slowly, such as global climatic changes, or they may happen quickly as in a forest fire, flood or the introduction of new plant or animal species.

The processes that shape (or change) the landscape are many. They include physical, biological and chemical processes that are related to surrounding environmental conditions. They vary in size, rate of spread and intensity, such as the slow decomposition and breakdown of organic matter into soil, the conversion of sunlight into organic material (photosynthesis) or the rapid consumption of organic matter in an intense forest fire. Processes are basically energy flows throughout the landscape. They add to, subtract from, or move energy around within the local ecosystem. The landscape is, essentially, a record of all the processes that have occurred up to that point in time.

Figure 14

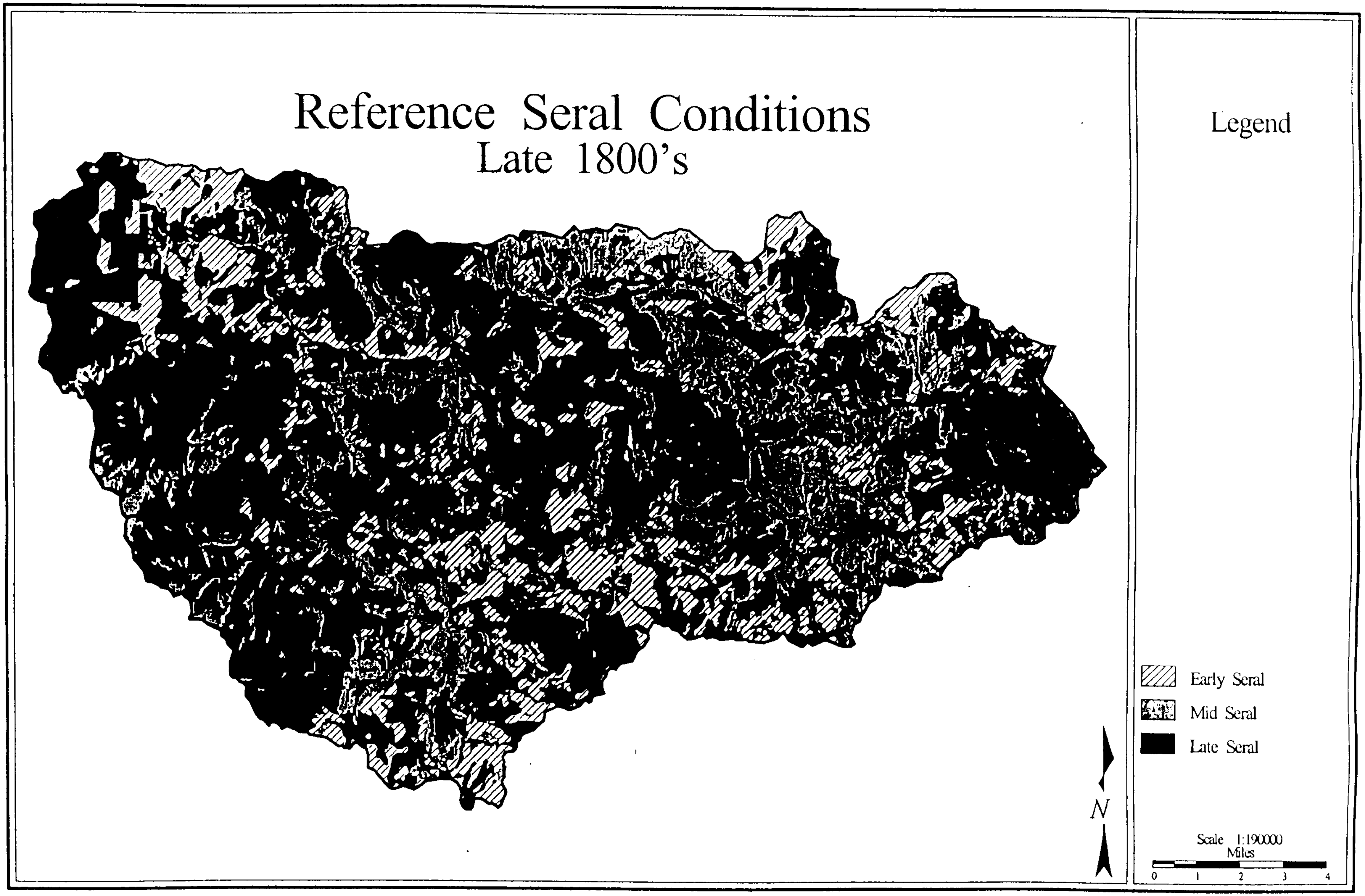
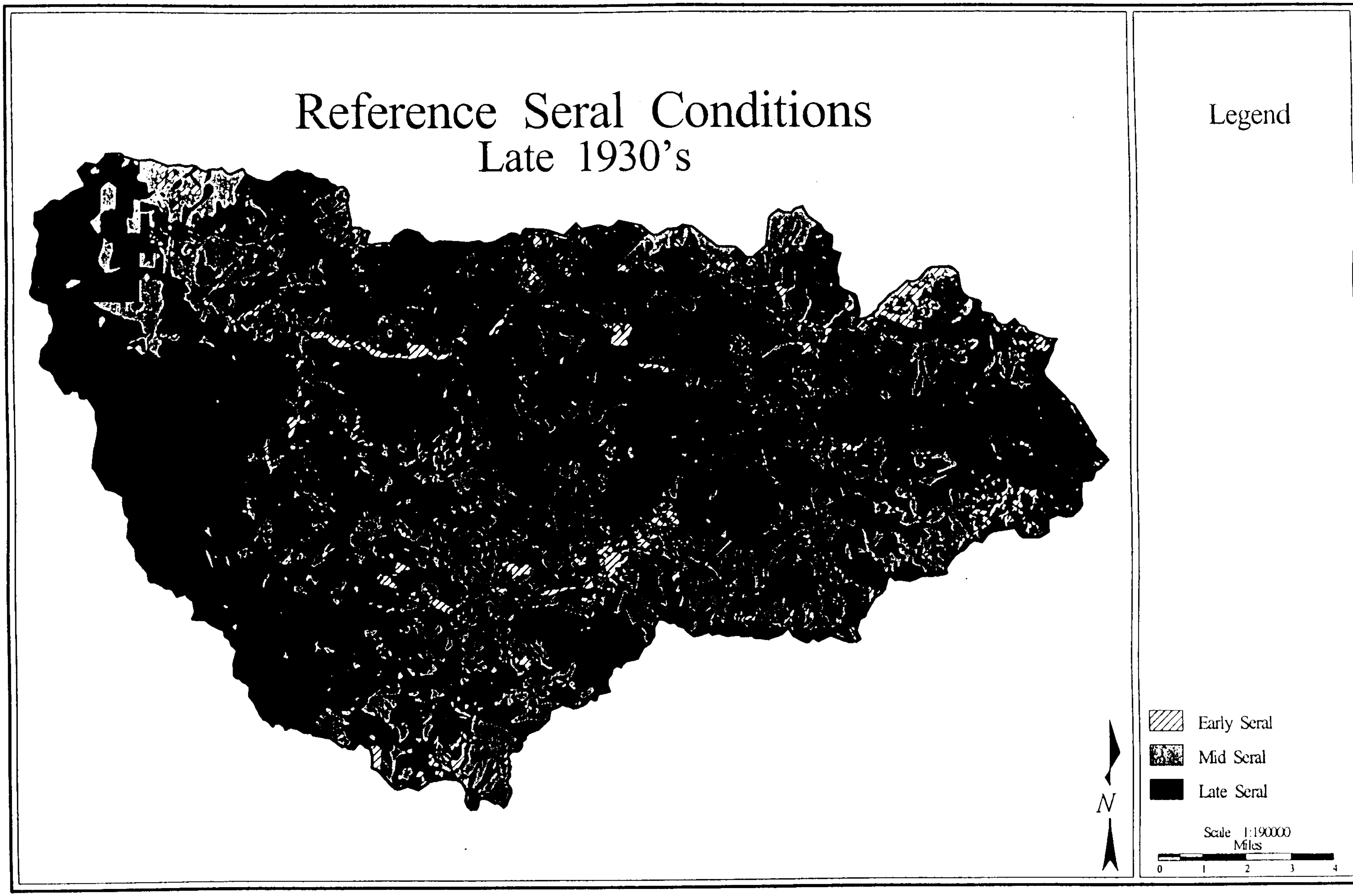
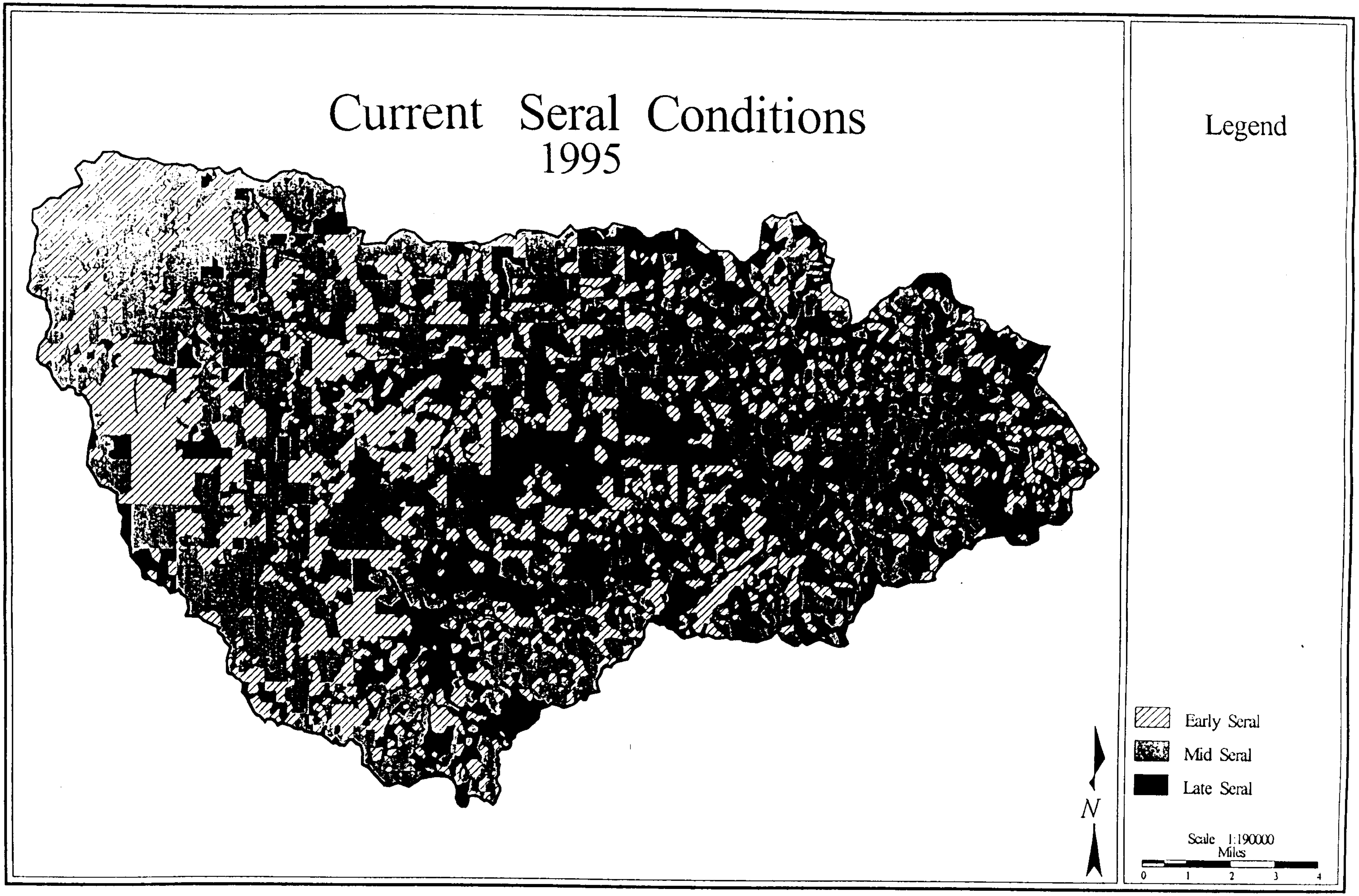

Reference Seral Conditions
Late 1800's
Legend
Early Seral
Mid Seral
Late Seral
N
Scale 1:190000
Miles
0 1 2 3 4

Figure 15



Reference Seral Conditions
Late 1930's
Legend
Early Seral
Mid Seral
Late Seral
Scale 1:190000
Miles
0
1
2
3
4
N

Figure 16


Current Seral Conditions
1995
Legend
Early Seral
Mid Seral
Late Seral
Scale 1:190000
Miles
0
1
2
3
4
N

Landscape patterns are the visible attributes of a landscape. Easily seen attributes, such as the vegetation, are the most obvious patterns. For this analysis of wildlife habitat, two basic landscape patterns were used. These patterns were delineated by seral conditions (which were based on tree size and distribution or the lack thereof). Landscape patterns are defined as:

MATRIX * = The dominant landscape pattern or "fabric of the land". It usually makes up more than 50 percent of the area and is the most connected element.
(*Not to be confused with the matrix allocation in the Northwest Forest Plan)

PATCH = The basic landscape unit. It can be a stand of timber, a clearcut or meadow. Patches are scattered or clumped throughout the matrix and are not connected.

The three seral stages that make up these landscape patterns are defined as follows:

EARLY SERAL = Grass, shrubs, forbs, rocky openings (openings in the forest canopy).

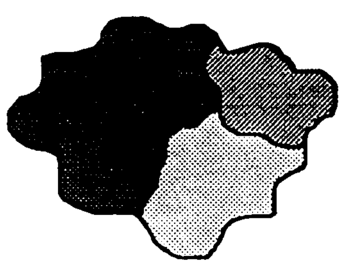
MID SERAL = Young stands of trees from about 25 to 100 years of age (most with closed canopies). This also includes hardwood stands.

LATE SERAL = Mature stands of conifers and old-growth.

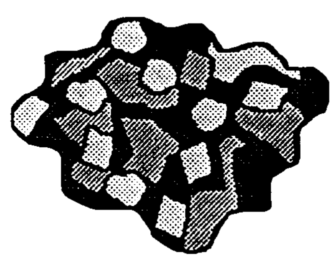
Various index values were used to describe both the matrix and patch components within each of the seven vicinities (see Appendix E). These values ranged from what percent of a vicinity each pattern took up, to values that correspond to patch shape and overall landscape diversity. The index values are described below (and in further detail in Appendix E):

<u>Percent Interior Habitat</u> = Percent of the landscape that contains interior habitat. Interior habitat is defined as that habitat within a late seral stand that is greater than 600 feet from a high contrast edge (i.e. early/late or grass/large tree) and 150 feet from a low contrast edge (i.e. mid/late or small tree/large tree).

<u>Fragmentation Index</u> = This index is a measure of the relative size and placement of patches within the landscape. A landscape with only a few large patches has a lower value than one with many small patches scattered throughout. Low values indicate a more contiguous, clumpy landscape. Higher values indicate a more fragmented, patchy landscape.

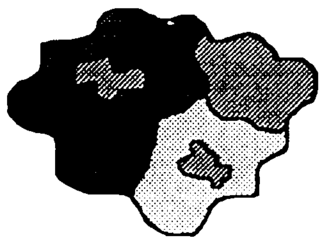


Low Fragmentation

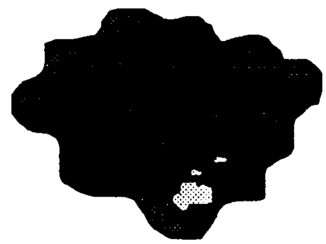


High Fragmentation

Diversity Index = This index represents the amount of landscape pattern diversity within the watershed. The higher this value is, the more diverse a landscape is or the higher the number of seral stages (or patches) and their distribution within the landscape. A landscape with only one or two seral stages with low fragmentation will have a lower diversity index value.



High Diversity



Low Diversity

The watershed's current seral conditions are outside of the reference range conditions. The largest deviation is seen in the amount of late seral which has decreased by as much as 40 percent to 50 percent from recent historical pre-timber management levels. Mid seral has increased by as much as 25 percent to 28 percent and early seral has increased by 9 percent to 25 percent. Two vicinities within the watershed, Black/Clover and Emile, have naturally lower amounts of late seral habitat and more early to mid seral. This is due to the land unit characteristics that dominate these vicinities (Western Cascade's dry/warm and moist/warm) and the steeper topography within them. Because of this, landscape pattern conditions within these vicinities are closer to their reference ranges.

Seral stage conditions fluctuated between the late 1800s and 1930s values shown in Figure 17. These values compare relatively closely with the findings of the Regional Ecological Assessment Report (REAP) of 1993. The range of early and mid seral forests fluctuated between 17 percent to 34 percent, where as REAP's estimation was 10 percent to 42 percent. Late seral habitat ranged from 69 percent to 80 percent, whereas REAP's estimation was from 48 percent to 76 percent. (Reference values used by REAP were for the entire Umpqua National Forest).

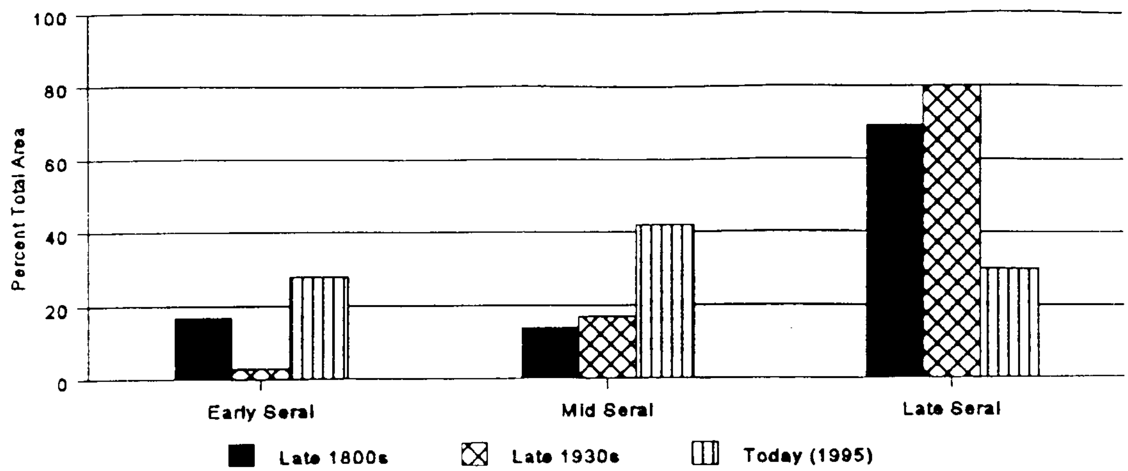


Figure 17. Seral stages within the Little River watershed as found in the late 1800s, the late 1930s, and today (1995).

As a result of intensive timber management, there has been a shift in the composition of seral stages over the landscape. Late seral forests are now patches, whereas historically they were the matrix. The matrix is dominated by mid seral forests.

One of the major changes, and one that has serious ecological implications, is the spatial shift of late seral habitat within the landscape. During the reference period, late seral habitat fell mostly within the gentle to moderate slopes of all land units. Within the moist/cool land unit, late seral was dominant, regardless of slope; the result of the historic fire regime. Today, most of the remaining late seral habitat occurs within the moderate to steep slopes of the dry/warm land unit or in places that naturally burned hot and frequently. This puts the remaining late seral habitat at high risk of being burned.

The majority of remaining mature conifer (82 percent) and old-growth (72 percent) is within land units (Figure 18) that have the highest risks of catastrophic fire.

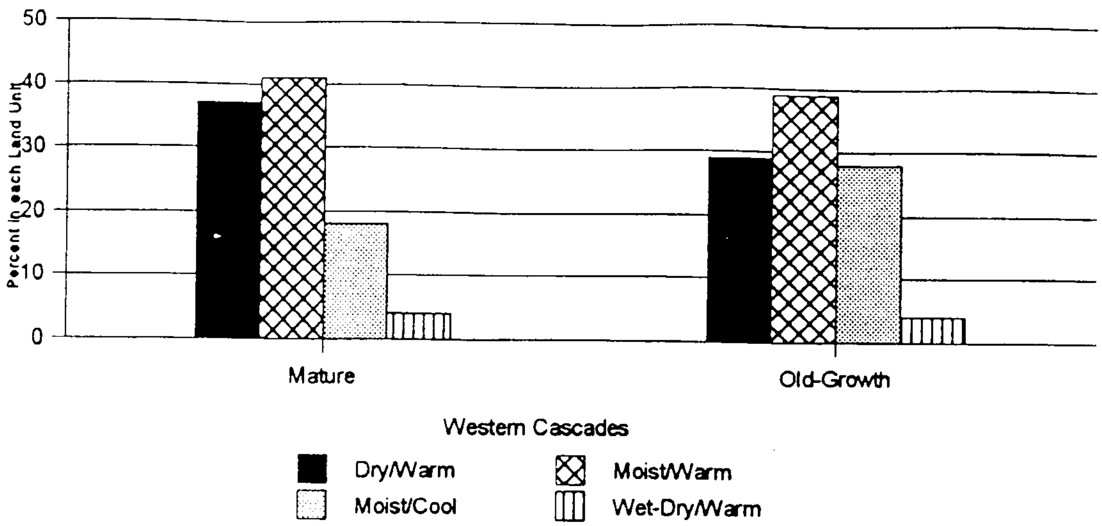


Figure 18. Current percentage of mature and old-growth coniferous forest in each land unit within the Western Cascades province of the Little River watershed

Structure Conditions

Landscape patterns of seral stages give us a coarse view of a watershed. Within the matrix and patches, however, there are finer differences in structure and species composition, depending on differences in soils, microclimate (moisture/temperature), geology and topography (represented by the land unit type).

The current landscape was divided into six structure stages similar to those described by Brown (1985). Table 16 and Figure 19 show how these structure stages fit into seral stages. Existing vegetation mapping of natural and managed stands was used to develop this structure division based on stand age and moisture/temperature conditions (see Table 4 of Appendix C).

TABLE 16. Summary of relationships between terms used to describe vegetation and habitat conditions .

STRUCTURE STAGES	FEMAT/ ROD	SERAL STAGES	DEER/ELK HABITAT	SPOTTED OWL HABITAT
Grass-Forb	Establishment	Early	Forage	Non Habitat
Shrub	Establishment	Early	Forage with some hiding cover	Non Habitat
Open Sapling-Pole	Establishment	Mid	Hiding cover with some forage	Non Habitat
Closed Sapling-Pole	Thinning	Mid	Hiding cover with some thermal cover	Dispersal
Mature Conifer	Maturation	Late	Maintenance forage with hiding and thermal cover	Nesting* Roosting Foraging Dispersal
Old Growth	Transition	Late	Maintenance forage with optimal cover	Nesting Roosting Foraging Dispersal

* Spotted owls may nest within this structure stage if suitable nesting structure is present (i.e. remnant old growth trees or snags)

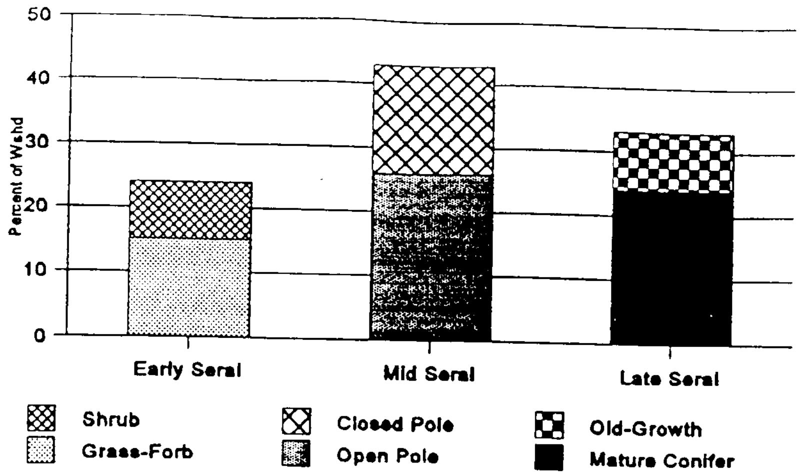


Figure 19. Current seral and structure stages within the Little River watershed.

Species richness, a measure of diversity, is simply the number of species present in a given habitat. Reptiles, mammals, birds, and amphibians all have different seral or structure stages they prefer as individuals. Within these stages, species richness is expected to vary (Figure 20). Some of the highest species richness occurs the late seral stages and hardwood dominated stands.

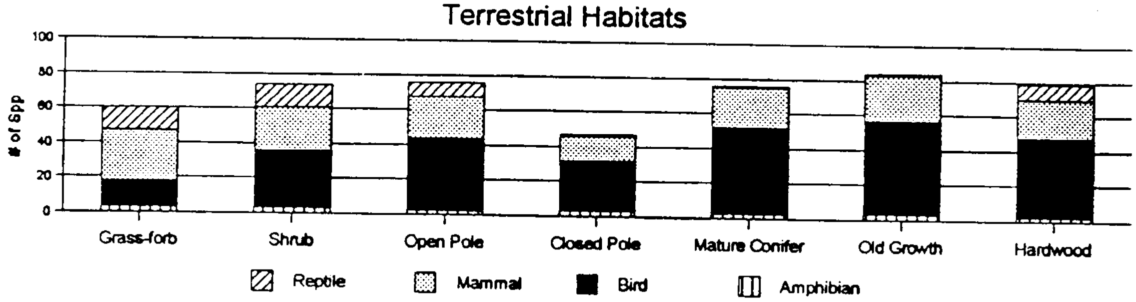


Figure 20. Expected species richness for terrestrial habitats in the Little River watershed.

In areas that have been managed for timber harvest, structure differs to varying degrees from that of unmanaged stands of the same age. Over the last 50 years, harvest has altered residual levels of biologically important components (snags and downed logs) in the watershed. Quantifiable data on Forest Service managed lands are lacking to compare between land units at this time, however, Table 17 was developed as a general guideline from limited field data and applies to Froest Service managed lands only (this data, along with professional judgement was used to determine numerical values displayed in Table 17). However, plot data from 78 plots in the Mount Scott Resource Area indicates that a minimum of 720 feet/acre of down logs (of which over 10% is >30 inches in diameter and over 40% is >18 inches dia.) occurs within all stand types (Joe Graham, BLM). Young forests had 1225 feet/acre of down logs while old growth forests had 1539 feet/acre. On Forest Service managed lands, further data on snag and log levels will be collected. Table 17 emphasizes deviations between managed and unmanaged/natural stands (reference conditions). Generally, the main deviation is the lack of snags and logs in managed stands; these are typically left after natural disturbances. Other deviations are evident in the development of understory vegetation in unharvested areas (natural stands) and fuels accumulations to levels much higher than natural because of fire suppression.

Table 17. Forest structural components by land unit for managed (MGD) and unmanaged (UNMGD) stands on Forest Service managed lands only in the Little River watershed.

Land Unit	Snags/Acre		Logs/Acre	
	MGD	UNMGD	MGD	UNMGD
Dry/Warm	0-2 (20-30in dbh)	6-10 (>30in dia)	* >5 † <2	11-15 (25-45in dia) (>50ft long)
Moist/Cool	0-2 (20-30in dbh)	3-5 (>26in dia)	* >5 † <2	12-20 (12-18in dia) (>30ft long)
Moist/Warm	0-2 (20-30in dbh)	4-8 (>30in dia)	* 2-5 † <2	12-20 (25-45in dia) (>30ft long)
Wet-Dry/Warm	0-2 (20-30in dbh)	3-5 (>26in dia)	* 2-5 † <2	10-15 (20-60in dia) (>30ft long)

* Harvest units prior to 1970 † Harvest units after 1970

Interior Habitat Condition

Although overall fragmentation of the landscape has only increased slightly by about 5 percent to 10 percent over natural levels, fragmentation of late seral habitat has been extensive resulting in a large decrease of interior forest habitat. Historically, interior forest normally covered between 40 percent to 51 percent of the total area of the watershed (Figure 21). Today it covers 12 percent of the watershed, with much of it intersected by roads, which further decrease its quality (Figure 22). Historically, interior forest habitat was most common within the moist, cooler areas especially on gentle slopes. Today, 40 percent of the remaining interior forest (Figure 23) lies within the Western Cascade dry/warm land unit. This puts the existing interior habitat at high risk of experiencing a high intensity fire.

Figure 21

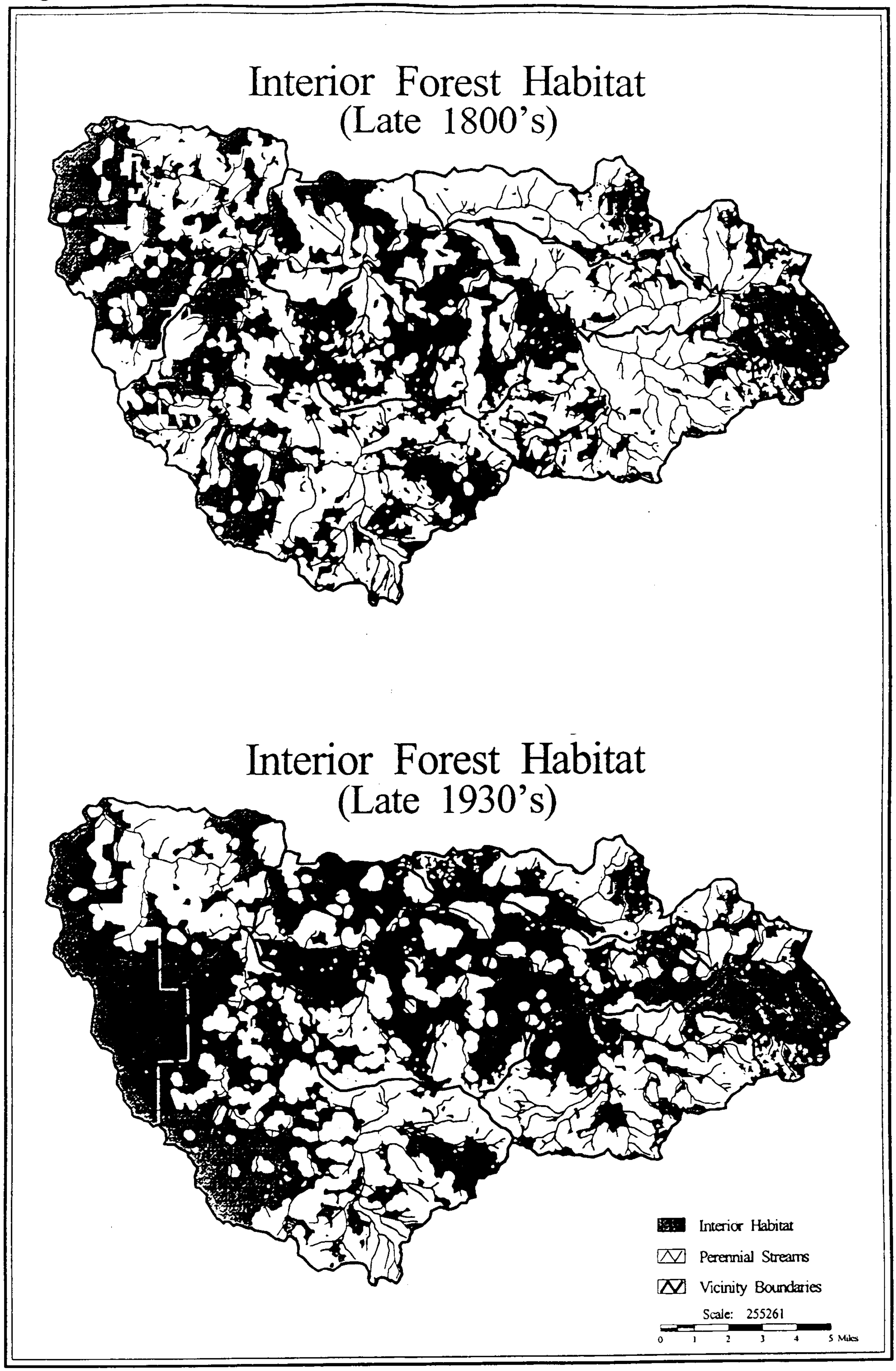
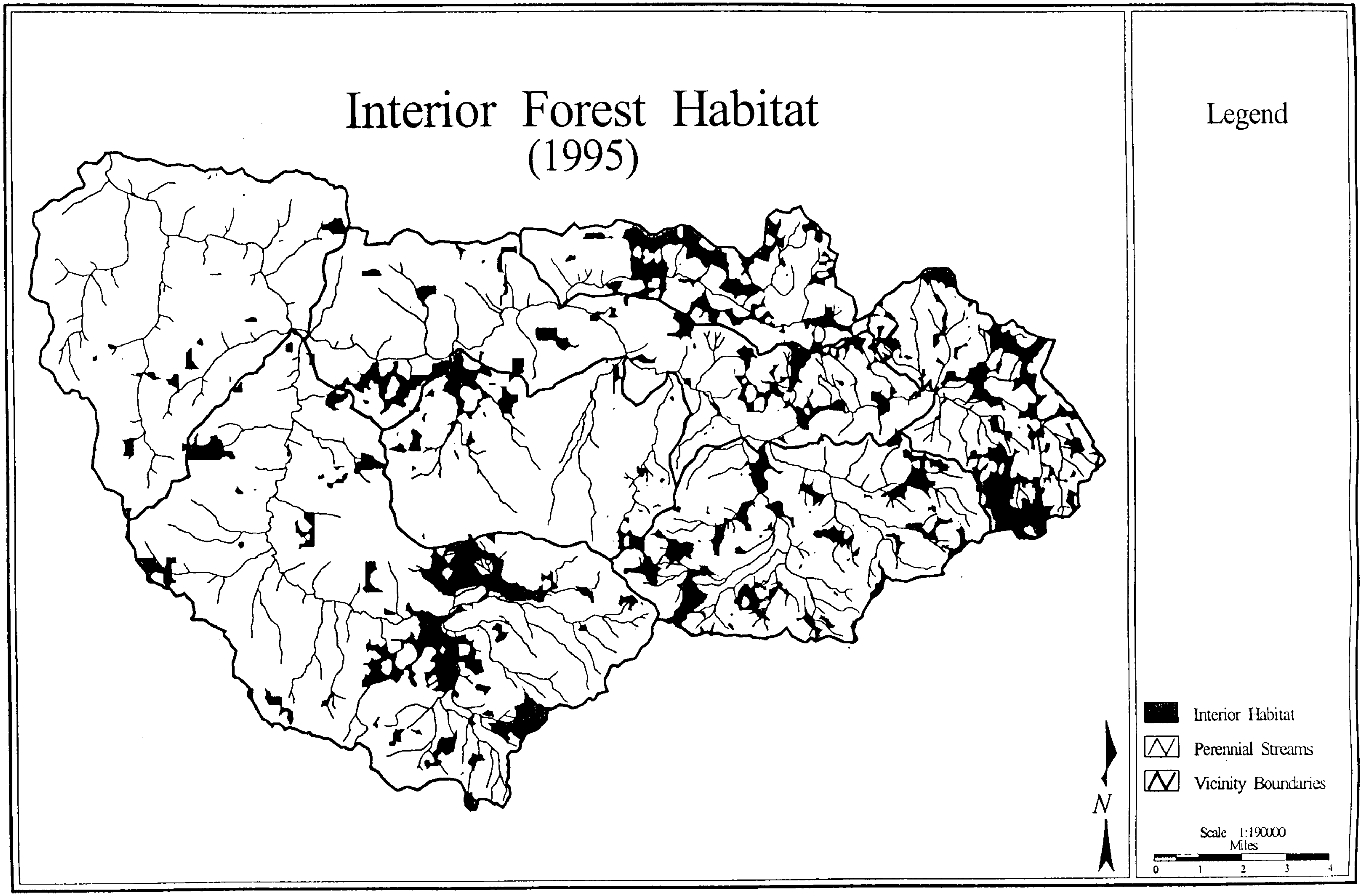

Interior Forest Habitat
(Late 1800's)
Interior Forest Habitat
(Late 1930's)
Interior Habitat
Perennial Streams
Vicinity Boundaries
Scale: 255261
0
1
2
3
4
5 Miles

Figure 22



Interior Forest Habitat
(1995)
Legend
Interior Habitat
Perennial Streams
Vicinity Boundaries
Scale 1:190000
Miles
0 1 2 3 4
N

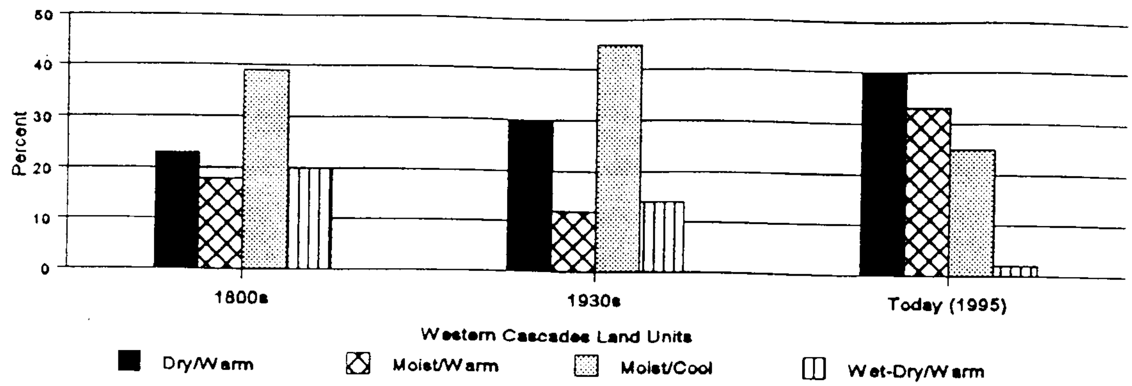


Figure 23. Percentage of interior habitat in each land unit within the Western Cascades province of the Little River watershed for the late 1800s, the late 1930s, and today (1995).

Most of the remaining interior habitat is physically located in the head water areas of streams; with little remaining along the bigger valley bottoms or along ridge tops. Lack of interior forest habitat greatly limits dispersal capabilities for many wildlife species. Species that prefer to travel along these previously mentioned topographic features are more severely impacted, such as the marten, which prefers to travel along upland corridors and ridges.

Riparian Habitat Conditions

Riparian areas are one of the most dynamic portions of the landscape (Gregory et al. 1991). This is because they constantly experience frequent (annual) disturbances on a small scale (floods, stream meander, landslides). They also contain greatly varying amounts of soil moisture. All this physical diversity results in very diverse plant and animal communities.

Water, food and cover are critical elements of wildlife habitat. Because all of these occur within riparian areas, riparian habitat is attractive to many species. To certain species this habitat is. critical to their survival; 82 percent of the wildlife species within the Little River watershed require healthy riparian habitat for their survival. Riparian corridors are also important routes for dispersal of plants and animals. The following three graphs show expected species richness for three types of riparian areas (Figure 24).

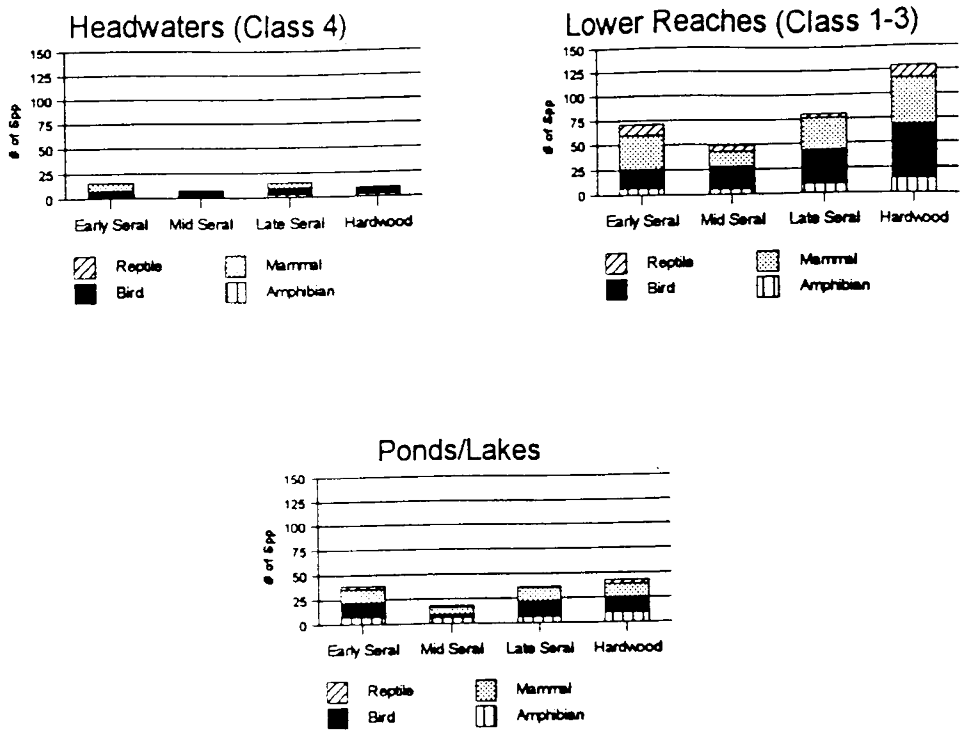


Figure 24. Expected species richness in headwaters of streams, lower reaches of streams, and ponds and lakes specific to Little River.

Riparian habitat has changed a lot over the last 50 years (Figure 25). During the reference period, both headwater and lower reaches were dominated by late seral habitat, while the lower reaches, which have wide valleys and gentle slopes, contained the majority of the riparian late seral habitat in the watershed. The large wood input produced by this habitat provided excellent understory structure and cover, while creating unique habitats that are lacking today such as ponds and marshes. It also provided many basking logs for turtles and log bridges over streams which improved small mammal dispersal from one side of the stream to the other. For further information on how long it takes for riparian areas to develop late seral characteristics, refer to Appendix C.

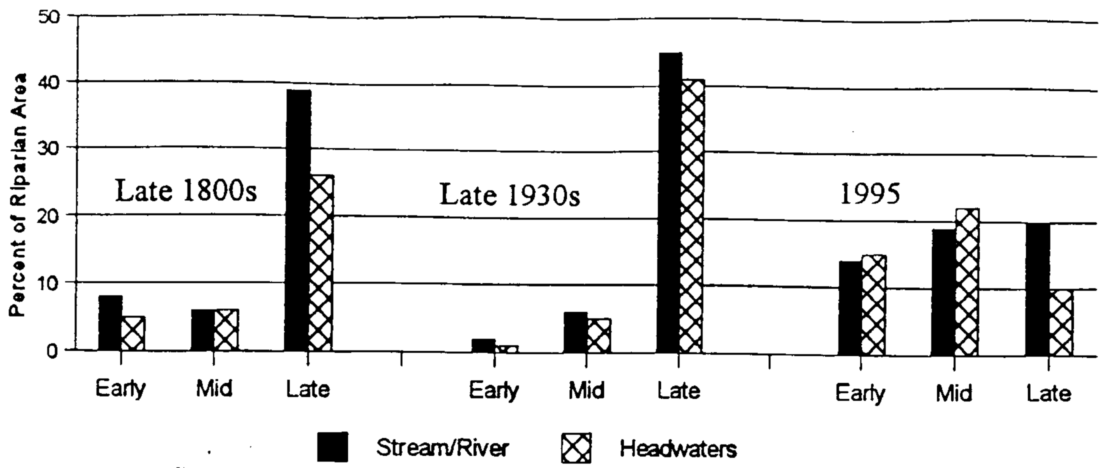


Figure 25. Changes in riparian habitat conditions among three periods: the late 1800s, the late 1930s, and today (1995). Differences in the amount of each seral stage found along the lower reaches of streams and along the headwaters of streams are displayed.

In addition to changes in seral stage and structure conditions, 23 percent of all roads within the watershed (961 miles) are located adjacent to streams, which diminishes the quality of this habitat to wildlife. Dispersal of small terrestrial animals, such as amphibians, is also negatively affected as culverts and roads create barriers.

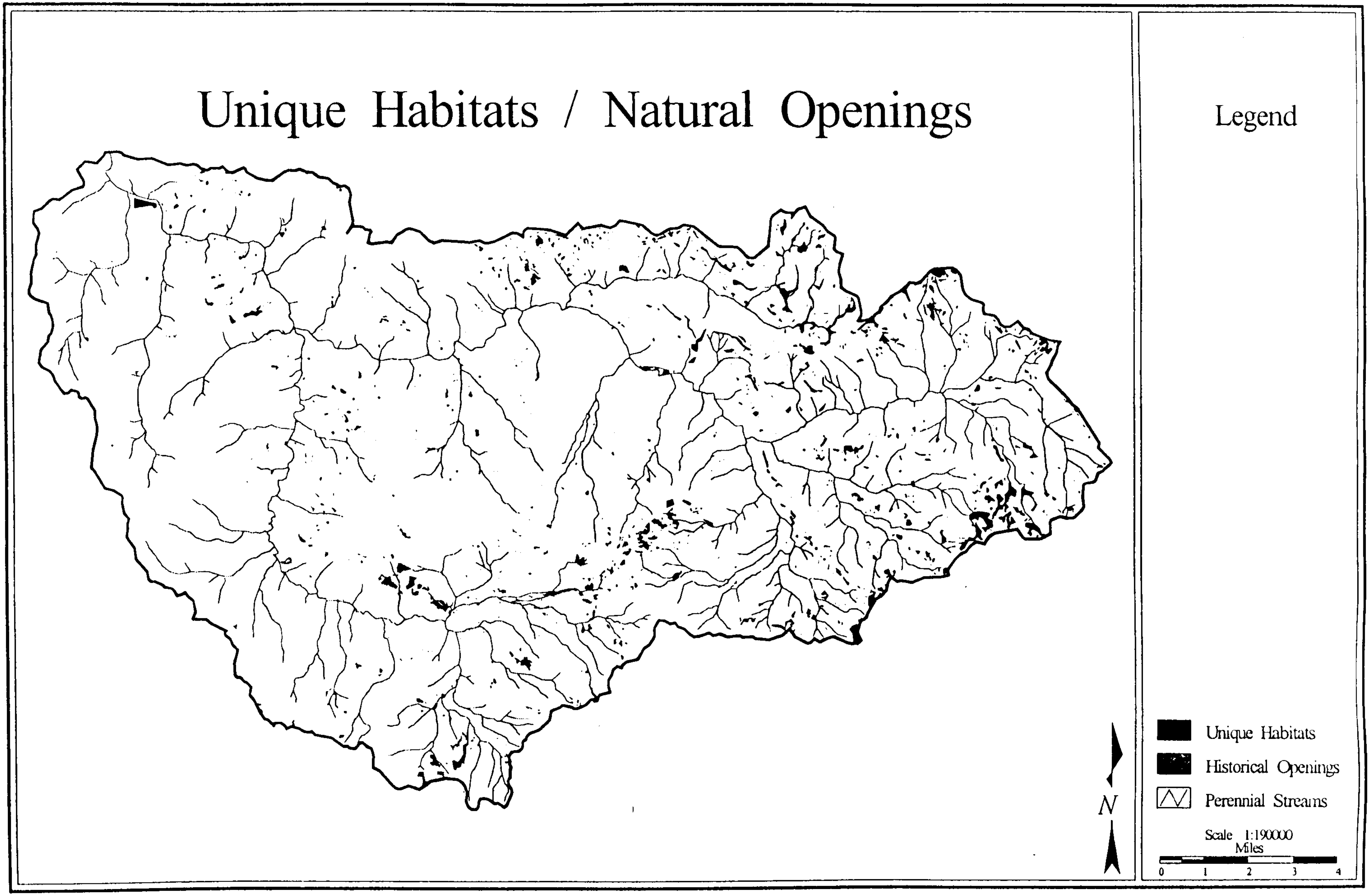
Unique Habitat Conditions

Currently, there are approximately 2,000 acres of unique habitats within the watershed. For this analysis, unique habitats refer to natural openings such as meadows, rock outcrops, and small ponds that were observed and mapped from aerial photos. This acreage has decreased by 68 percent since the late 1930s because of clearcutting and road construction through and/or around these natural openings. Figure 26 shows the distribution of these habitats along with the historic locations based on aerial photo interpretation from 1946 photos.

A few wet meadow/marsh complexes have been dammed and flooded to create fishing ponds and lakes such as Hemlock Lake, Red Pond, Cultus Lake and Lake in the Woods. Tractor logging has created many small ponds (less than 100 feet across) through the compaction of soils along gentle slopes especially at the toeslopes of steep hillsides. In addition, many small ponds have been created along roads to serve as water sources for fire suppression.

An unknown number of small, unmapped unique habitats exist throughout the Little River watershed because their small sizes and/or location (usually underneath the canopy) makes them hard to locate without intensive field reconnaissance. These unmapped unique habitats are mostly small seeps, talus, and cedar swamps.

Figure 26


Unique Habitats / Natural Openings
Legend
Unique Habitats
Historical Openings
Perennial Streams
Scale 1:190000
Miles
0 1 2 3 4
N

These special habitats, while accounting for a small number of acres within the watershed, are used by a large percentage (87 percent) of the local wildlife for primary breeding and feeding purposes (Figure 27).

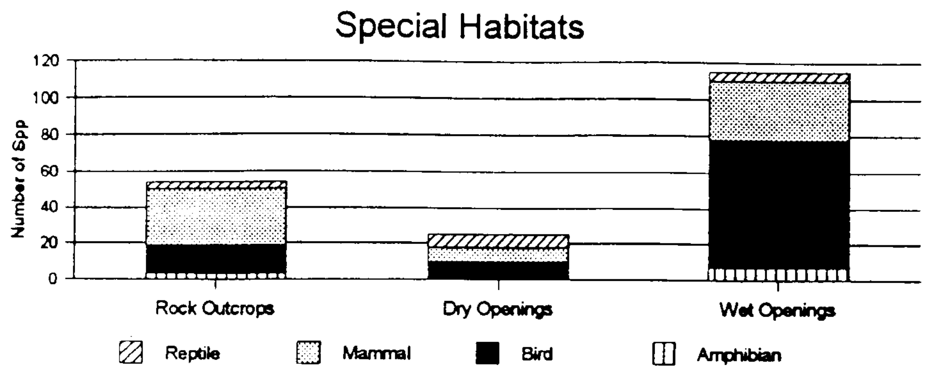


Figure 27. Expected species richness for special habitats within the Little River watershed.

The Wetter Openings

Fifty-three percent of the unique habitats are seasonally to permanently wet meadows. These wetter openings almost consistently lie within the Western Cascade's moist/cool and moist/warm land units. They always occur on the gentle to moderate slopes where soils are deeper and ground water is better retained. In the warmer areas, they tend to become only seasonally wet then dry up during the summer months. This allows the surrounding vegetation to grow inward from the edges, eventually closing these openings. Basically, the wetter the opening is the longer it stays open, because many tree species cannot survive in over-moist soil conditions. Some shrub species, especially willow, are the first to vegetate these openings and can survive over time where trees cannot grow. Another factor which effects the length of time these habitats stay open is elevation which correlates to the length of the growing season. Wet openings in the Yellow Jacket Glade and Hemlock Lake area have very slow succession rates because of the wetter conditions and shorter growing seasons.

The wetter unique habitats are often surrounded by a wider and more diverse band of vegetation consisting of a mix of hardwoods, shrubs and conifer. The edges are usually less abrupt as opposed to the edge along a dry meadow. These openings tend to be larger than their dry counterparts, averaging seven acres in size.

The Drier Openings

Approximately 26 percent of the mapped unique habitats are dry meadows. These openings, found in the drier/warmer land units, usually occur on steep slopes and the upper 1/3 of the slope to ridge tops. The length of time these habitats stay open is also related to moisture/temperature conditions and soil depths. The openings in the hottest and driest areas and with the shallowest soils, tend to remain open longer because of poor growing conditions for trees. They are frequently surrounded by mid seral habitat and hardwoods such as canyon live oak and Pacific madrone, mainly because they occur in areas with the highest frequency and intensity fires, which aid in keeping these places open.

Dry openings are more susceptible to damage from mechanical soil disturbance since the soil layer is usually very thin. Once disturbed, it usually takes a very long time for the damage to naturally heal itself. These dry openings tend to be, smaller than their wetter counterparts with an average size of 2.5 acres.

In general, both extremes of the moisture/temperature band reduce tree growth suitability and make for long term natural openings.

Rock Outcrops

Rock outcrops make up about 21 percent of the mapped unique habitats and are almost always intermingled with small patches of dry meadows. Moss covered seeps and talus can usually be found at the base of north and northwest facings rock surfaces. These habitats are very permanent through time for obvious reasons.

Most of the watershed's rocky outcrops occur within the Western Cascade geologic province. All of these rock outcrops are formed from rock resistant to weathering, with approximately 92 percent lying within the tuff, breccia and basaltic rock units (Table 18).

Table 18. Occurrence of rock outcrops in relationship to geology.

Rock Unit	Percent Total	Average Size (ac)	General Description
Tuffs	29	1.5	Cliff and spire forming with small rock cavities, in dissected terrain, light colored rock with widely spaced fracturing. Soils at base are low in organic matter and pH.
Basaltic lava flows	25	6	Basaltic lava flows, columnar, dark colored rock, very resistant to weathering. Have the highest amount of cracks and crevices/ledges. Form cliffs and bluffs (Black Rock, Foster Butte).

Rock Unit	Percent Total	Average Size (ac)	General Description
Sedimentary and volcanic rocks	21	4	Tuffs and breccia which slowly weather into silty, clay-rich soil. Very diverse rock types showing many of the characteristics of the basaltic lava flows and tuffs.
Colestin formation	17	1	Mostly avalanche and landslide deposits , large blocks of basaltic lava flows and tuffs. Scattered intrusions of welded tuffs.

Rock outcrops (especially those within the Tuff and Basaltic lava flow rock units) include cliff, cave and crevice features. These are extremely important to certain wildlife such as peregrine falcons, ringtail and bat species (in particular the Townsend's big-eared bat).

Ponds

Historically, large ponds greater than one acre in size were not common within the watershed. Most natural ponds were associated with beaver activity and other stream channel dynamics (meandering and debris dams). As the construction of roads proceeded eastward into the watershed, some of the naturally wet openings were dammed and stocked with hatchery fish (i.e. Cultus Lake, Lake in the Woods, Red Pond). Present day Hemlock Lake was initially created to serve as a rearing pond for hatchery fish.

Over 150 ponds averaging 30 feet across have been constructed along roads, for fire suppression purposes; many of these were also stocked with trout. The last stocking of fish in these sumps occurred in 1991. It is unlikely that many fish survive through the summer in the smaller ponds due to high water temperatures.

Tractor logging has also created areas with sags ponds resulting from soil compaction. Overall, there has been a net gain of ponds outside of stream channels (where they usually occurred naturally) and an overall decrease in ponds within stream channels as a result of historical land management activities described in Chapter 4 (stream cleanout, Aquatic-14).

Hardwood Stands

Hardwoods are found throughout the Little River watershed but usually do not dominate a particular stand except for areas within the northwestern portion of the watershed, along the hills adjacent to and north of lower Little River. It is in this area that the historic coniferous forest began to transition into the oak woodlands that bordered the grassy valleys and hills of the Umpqua Valley.

Both historically and today, hardwood-dominated stands probably occur in thin strips along riparian corridors as a result of the occasional natural landslide, flood or shifting stream channel. Hardwoods, such as red alder and bigleaf maple, are able to persist and dominate these areas until shade-tolerant conifer species eventually crowd them out. Riparian areas are unique from this stand point because, vegetation-wise, they are the most diverse and dynamic areas of the landscape. This is due to the constant shifting, meandering and small scale natural disturbances that occur in these areas over time.

Hardwoods are also able to dominate areas such as the shallow-soiled, dry ridgetops. In these areas Pacific madrone, golden chinquapin and canyon live oak can be found

Because hardwood dominated stands contain some of the highest wildlife species diversity and richness and because they are so uncommon within the watershed they should be considered as unique habitat. Currently, mature hardwoods (especially Pacific madrone) within the watershed are decreasing, especially along road systems where access to firewood cutting is greatest. Past firewood policies have encouraged cutting standing hardwood trees. This policy was recently reversed in 1994.

Game Animals

The following wildlife, which occur within the Little River watershed, are listed as game animals by the Oregon Department of Fish and Wildlife (Table 19):

Table 19. Game species in the Little River watershed.

Big Game	Furbearers	Birds	Amphibians
Black Bear	Beaver	Band-tailed pigeon	Bullfrog*
Cougar	Bobcat	Mourning dove	
Deer	Marten	Grouse	
Elk	Mink	Quail	
Western gray squirrel	Muskrat	Wild turkey*	
	River otter	American coot	
	Raccoon	Ducks	
	Red fox	Geese	
	Gray fox	Mergansers	
		Common snipe	
		Ring-neck pheasant*	

* Non-native species

Populations are managed by the regulation of hunting and trapping, introductions and transplanting, and through habitat management. The game species of concern within the Little River watershed are elk, deer, marten and band-tailed pigeon.